

# WEST LAKE LANDFILL OPERABLE UNIT 2 RI/FS

### SITE CHARACTERIZATION SUMMARY REPORT

Volume 1 of 2



40053007 SUPERFUND RECORDS

WATER
MANAGEMENT
CONSULTANTS

## WEST LAKE LANDFILL OPERABLE UNIT 2 RI/FS

### SITE CHARACTERIZATION SUMMARY REPORT

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#### 1 PURPOSE AND OBJECTIVES

This report presents the results of site characterization activities conducted as part of the West Lake Landfill Operable Unit 2 Remedial Investigation/Feasibility Study (RI/FS). The report provides the following information, consistent with Section 3.4.1 of the RI/FS Statement of Work (SOW):

- a review of the investigative activities that have taken place,
- a description of data collected to document the location and characteristics of surface and subsurface features and contamination, including affected media, location, types, physical state, concentration of the contaminants, and quantity, and
- the location, dimensions, physical condition, and varying concentrations of each contaminant throughout each source and the extent of contaminant migration through each of the affected media.

Field investigative activities were designed to meet the objectives of Section 3.1 of the SOW. As described in the EPA-approved Remedial Investigation/Feasibility Study Work Plan, West Lake Landfill Operable Unit 2, Bridgeton, Missouri (Work Plan), Appendix A-1, Field Sampling Plan prepared by Golder Associates Inc. (Golder, 1995), the primary objectives of the West Lake Landfill Operable Unit 2 (OU-2) RI were to collect data on and adjacent to OU-2 regarding environmental characteristics, chemical occurrence, potential chemical migration pathways, and transport mechanisms.

The tasks that were proposed to meet the objectives of the SOW were summarized in Work Plan as follows:

Define site physical and biological characteristics

- surficial geologic investigation
- ecological evaluation
- collection of additional information on site physical characteristics and demographics

#### Characterize site hydrogeologic characteristics

- evaluation of existing well integrity
- initial hydrogeologic investigation
- technical memorandum recommending groundwater quality monitoring network
- determine groundwater quality

#### Define sources of contamination

- leachate sampling and analysis
- landfill gas characterization
- investigation of potential petroleum impacts near well MW-F2
- evaluation of potential impacts to groundwater

#### Determine surface water and sediment quality

- surface water sampling and analysis
- seep survey, sampling, and analysis

#### Determine air quality

Site physical and hydrogeologic characteristics were previously detailed in the *Physical Characterization Technical Memorandum for the West Lake Landfill Operable Unit 2, Bridgeton, Missouri* (Physical Characterization Memorandum) prepared by Golder and dated August 1996. The Physical Characterization Memorandum also recommended a groundwater quality network for the site. This Site Characterization Summary Report discusses the remainder of the RI tasks, which include site biological characteristics, sources of contamination, groundwater quality, surface water and sediment quality, and air quality.

#### 2 BACKGROUND AND SITE DESCRIPTION

The West Lake (Bridgeton) Landfill site is a 212-acre facility located within the City of Bridgeton, St. Louis County, Missouri (Figure 2.1). The site address is 13570 St. Charles Rock Road (Figure 2.2). The site includes an active solid waste landfill, an inactive demolition landfill, an inactive landfill, concrete and asphalt plants, and an automobile repair shop (Figure 2.3). The site was used agriculturally until 1939, when a limestone guarry and crushing operation was initiated.

As shown in Figure 2.2, the West Lake Site is bounded on the north by St. Charles Rock Road and on the east by Taussig Road and agricultural land. Old St. Charles Rock Road borders the southern and western portions of the site. Property north of the site (across St. Charles Rock Road) is moderately developed with commercial retail and industrial operations. The property northeast of the site is also developed for commercial uses. The property south of the site is currently experiencing significant commercial development. The Earth City industrial park is adjacent to the site on the west. The West Lake Site is now almost completely surrounded by commercial/industrial properties.

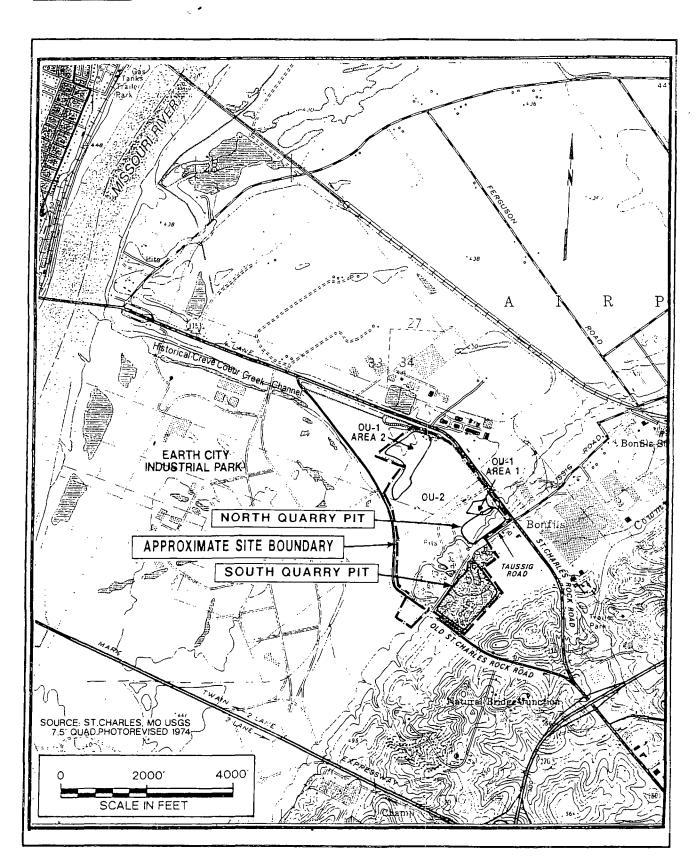
The site is located on the eastern edge of the Missouri River floodplain. The Missouri River is located approximately two miles west of the site. The site remained above the high water elevation during the St. Louis-area floods of 1993 and 1995. The area is transitional between the alluvial floodplain immediately to the west and the loessial bluffs 0.5 miles to the east. The edge of the alluvial valley is oriented north to south through the center of the site (Figure 2.3). Topography in the area is gently rolling. However, site topography has been significantly altered by quarry activities in the eastern portion, and placement of mine spoils (unused quarry rock) and landfilled materials in the western portion.

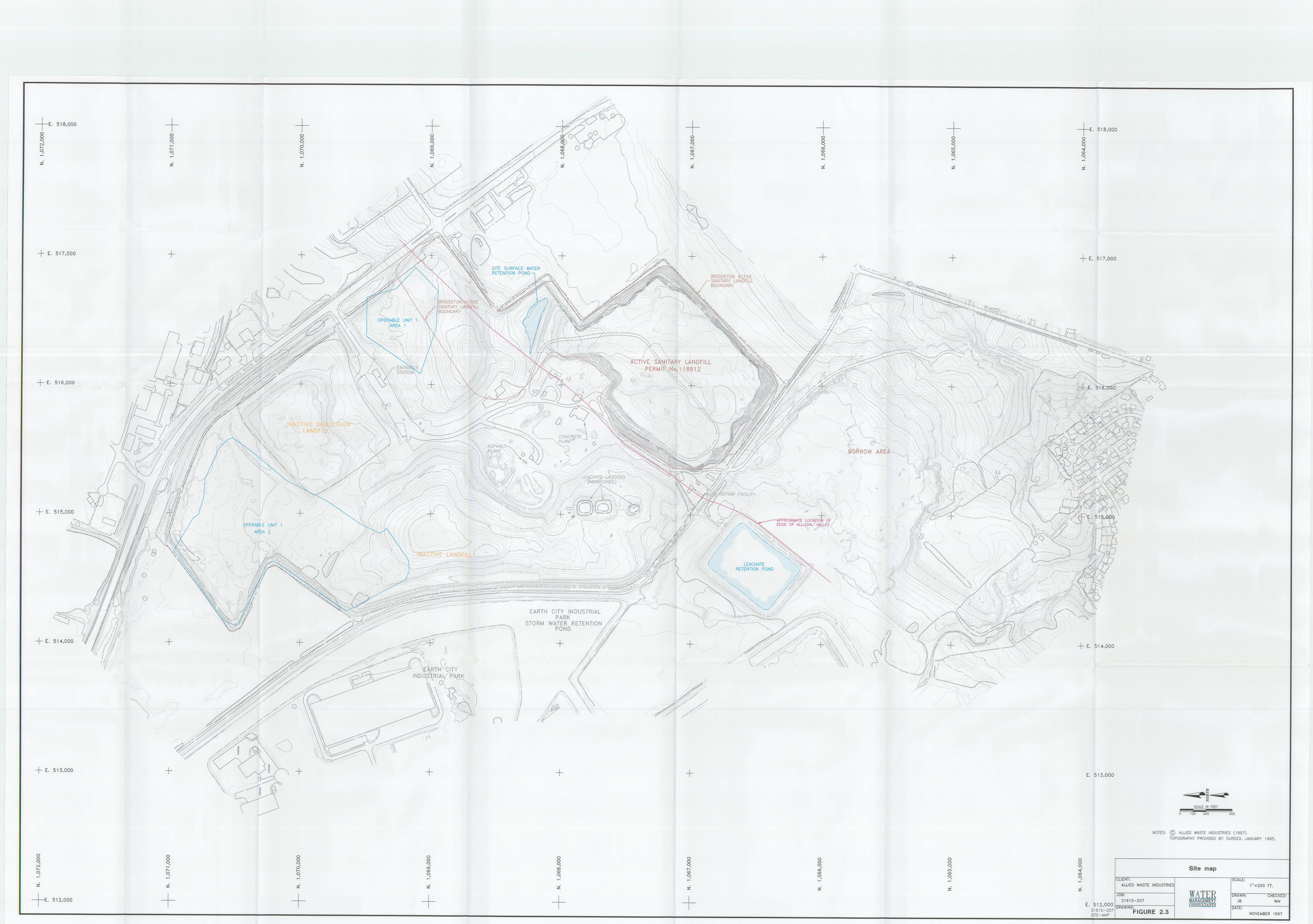
The limestone quarry was operated between 1939 and 1988, and was closed when economically recoverable reserves were exhausted. The quarry consists of two pits, which were excavated to a maximum depth of about 240 ft below ground surface (bottom elevation of about 240 ft above mean sea level, MSL). The active sanitary landfill is operated within the former limestone quarry. Landfilling operations were initiated within the north pit of the quarry in 1979. Landfilling in the north pit terminated at a maximum elevation of about 500 ft MSL. Currently, active landfilling is taking place in the south pit, which is filled with solid waste to a depth of about 20 to 40 ft below ground surface (440 - 460 ft MSL elevation).

The landfill has been constructed with a gas collection system and separate leachate collection system. The gas collection system is designed to alleviate potential odor problems and recover gas for potential beneficial use. The leachate collection system is of hydrogeologic importance because it is designed to remove surface water and groundwater which flow into the active sanitary landfill. The leachate collection system, therefore, acts as a groundwater sink to the aquifers surrounding the active landfill. The leachate collection system currently includes four leachate collection sumps, LCS-1 through LCS-4 (Figure 2.4). These have been fitted with pumps which discharge pumped leachate to an adjacent lined retention and aeration pond (referred to as the Leachate Retention Pond). The sumps are located near the four corners of the south pit, and extend from the active sanitary landfill surface to the pit floor. In accordance with terms of the landfill permit, the sump pumps are typically activated to maintain a maximum 30 ft of leachate head in the landfill. The leachate collection system collects an average of about 200,000 gallons of leachate per day from the active landfill area. The collected leachate is pumped to the leachate pond for treatment and subsequent discharge to the St. Louis Metropolitan Sewer District.











#### 3 BIOLOGICAL CHARACTERISTICS

The entire area surrounding the West Lake Landfill is rapidly being developed for commercial/light industrial purpose. The area north of the landfill across St. Charles Road, as well as the area west of the landfill in Earth City, has previously been developed. Subsequent to initiation of the OU-2 RI/FS, the areas south and east of the landfill have also undergone extensive commercial/light industrial development. The heavy development in the area has eliminated almost all previously existing plant and animal habitats, and has therefore significantly reduced the number and type of potential ecological receptors.

The biological characteristics near the West Lake Landfill were evaluated as part of the West Lake Landfill Operable Unit 1 (OU-1) RI/FS. As described in the Site Characterization Summary Report prepared by Engineering Management Support, Inc. and dated August 1997, the U.S. Fish & Wildlife Service reported "no federally-listed endangered or threatened species occur in the project area". The Missouri Department of Conservation reported "Department staff examined map and computer files for federal and state threatened and endangered species and determined that no sensitive species or communities are known to occur on the immediate Site or surrounding area". An unsubstantiated and unverified report of a Western Fox Snake near the site was made. Subsequent examinations of areas most likely to be inhabited by the Western Fox Snake by McLaren/Hart Environmental Engineering Corporation as part of OU-1 RI/FS activities failed to confirm the presence of the Western Fox Snake.

The OU-1 biological survey identified numerous species and signs of wildlife. Deer tracks were noted, and rabbits were observed. Red-winged black birds, robins, and crows were also observed. A great blue heron was observed in the Earth City stormwater retention pond. The possible presence of coyotes or red fox was inferred from observation of several pellets containing fur.

As described in the *Work Plan*, the ecological evaluation performed for the Operable Unit 1 RI/FS was intended to form the basis for describing biological characteristics for Operable Unit 2. If the OU-1 biological evaluation were determined to be insufficient, supplemental activities would be performed as part of the OU-2 RI/FS. Given the lack of sensitive ecological receptors (ie, threatened or endangered species) identified by OU-1, combined with the extensive human-made impacts to the area through commercial/light industrial development activities, the existing biological data are sufficient to quantify risks posed by OU-2, and no further biological investigations are proposed.

#### 4 GROUNDWATER QUALITY

#### 4.1 Overview

The *Work Plan* indicated that a groundwater quality monitoring network would be developed for OU-2 based on a detailed review of the site hydrogeologic conditions, including:

- horizontal and vertical flow directions.
- horizontal and vertical hydraulic gradients,
- aguifer and aguitard permeabilities, and
- relationship of monitoring points to potential sources of contamination.

A detailed review of the site hydrogeologic conditions was presented in the *Physical Characterization Memorandum*. Four principal hydrogeologic units capable of yielding sufficient water for sampling were identified within and near OU-2. These included, from youngest to oldest, the alluvium, the St. Louis/Upper Salem hydrogeologic unit, the Salem Formation, and the Keokuk Formation. The alluvium is present in the western half of the site (see Figure 2.3). On the eastern portion of the site, the uppermost water is perched within a loess deposit that overlies the St. Louis/Upper Salem hydrogeologic unit, consisting of limestone and dolomite. The St. Louis/Upper Salem hydrogeologic unit grades into the underlying Salem Formation, which is also predominantly limestone. The Warsaw Formation, a claystone and siltstone aquitard commonly referred to as the Warsaw Shale, is present between the Salem Formation and the Keokuk Formation. The Keokuk Formation was classified as predominantly limestone.

The extensive physical characterization at the site allowed development of a detailed hydrogeologic model based on the bulleted items listed above. As depicted in Figure 4.1, leachate collection from the active landfill is the major hydrogeologic feature at the site. Leachate collection has maintained an inward hydraulic gradient from the adjacent Salem, St. Louis/Upper Salem, and alluvial hydrogeologic units that was developed when the limestone quarry created a local hydraulic sink by excavating below the water table. The inward hydraulic gradient prevents horizontal migration of leachate away from the landfill into the surrounding units. Vertical migration away from the active landfill is prevented by a combination of low-permeability shales that form a natural landfill liner, leachate pumping, and an upward hydraulic gradient from the underlying Keokuk Formation.

The leachate collection process has maintained a groundwater divide west of the active landfill. East of the divide, groundwater flow is toward the landfill and the leachate collection system. West of the divide, groundwater flow is relatively flat, but generally trends west/northwest toward the Earth City Stormwater Retention Pond.

The OU-2 RI included installation of 49 piezometers to characterize the site hydrogeology and to monitor groundwater elevations in alluvial and bedrock aquifers. These supplemented existing piezometers and monitoring wells across the site. From the newly-installed piezometers and previously existing piezometers/wells, 24 locations were proposed for inclusion in the groundwater quality monitoring network for OU-2. Figure 4.2 illustrates the OU-2 monitoring locations, plus OU-1 monitoring wells and piezometers. The wells and piezometers sampled in the OU-1 RI are discussed in OU-1 deliverables.

Because groundwater in the Keokuk Formation is hydraulically isolated from the overlying hydrogeologic units, groundwater quality monitoring in the Keokuk Formation was not performed, as described in the *Physical Characterization Memorandum*. Groundwater quality monitoring from the upper two bedrock hydrogeologic units and the alluvium was performed. Five monitoring points were established in the Salem Formation. The base of the active sanitary landfill is adjacent to the Salem Formation. Salem Formation monitoring locations would be the first locations to detect releases from the active sanitary landfill. Even though available data indicate that all St. Louis/Upper Salem monitoring points are upgradient of the active landfill, 12 St. Louis/Upper Salem is the uppermost bedrock unit at the site, and is present adjacent to the active sanitary landfill. Seven alluvial monitoring locations were sampled for groundwater quality. Detailed rationale for the selected monitoring locations is presented in the *Physical Characterization Memorandum*.

#### 4.2 Drill water sample results

During bedrock drilling, it was necessary to add water to the holes to cool the drill bit and facilitate coring. The source of the drill water was the municipal water supply to the concrete batch plant. The drill water sample was analyzed for a full suite of compounds, including volatile organic compounds (VOCs), semi-volatile organic compounds, pesticides, PCBs, TPH, metals, and general inorganics. Appendix A presents the laboratory analytical sheets for the drill water sample. Table 4.1 lists the compounds detected in the drill water sample. Chloroform was the only VOC present above the laboratory reporting limit. Chloroform was probably present as a result of municipal water treatment. No semi-volatile organic, pesticide, PCB, or TPH compounds were detected above the laboratory reporting limits.

Extensive development activities were performed after installation of the piezometers, as described in the *Physical Characterization Memorandum*. In addition, all piezometers were purged prior to groundwater sample collection. The development and purging activities were conducted to allow collection of representative groundwater samples.

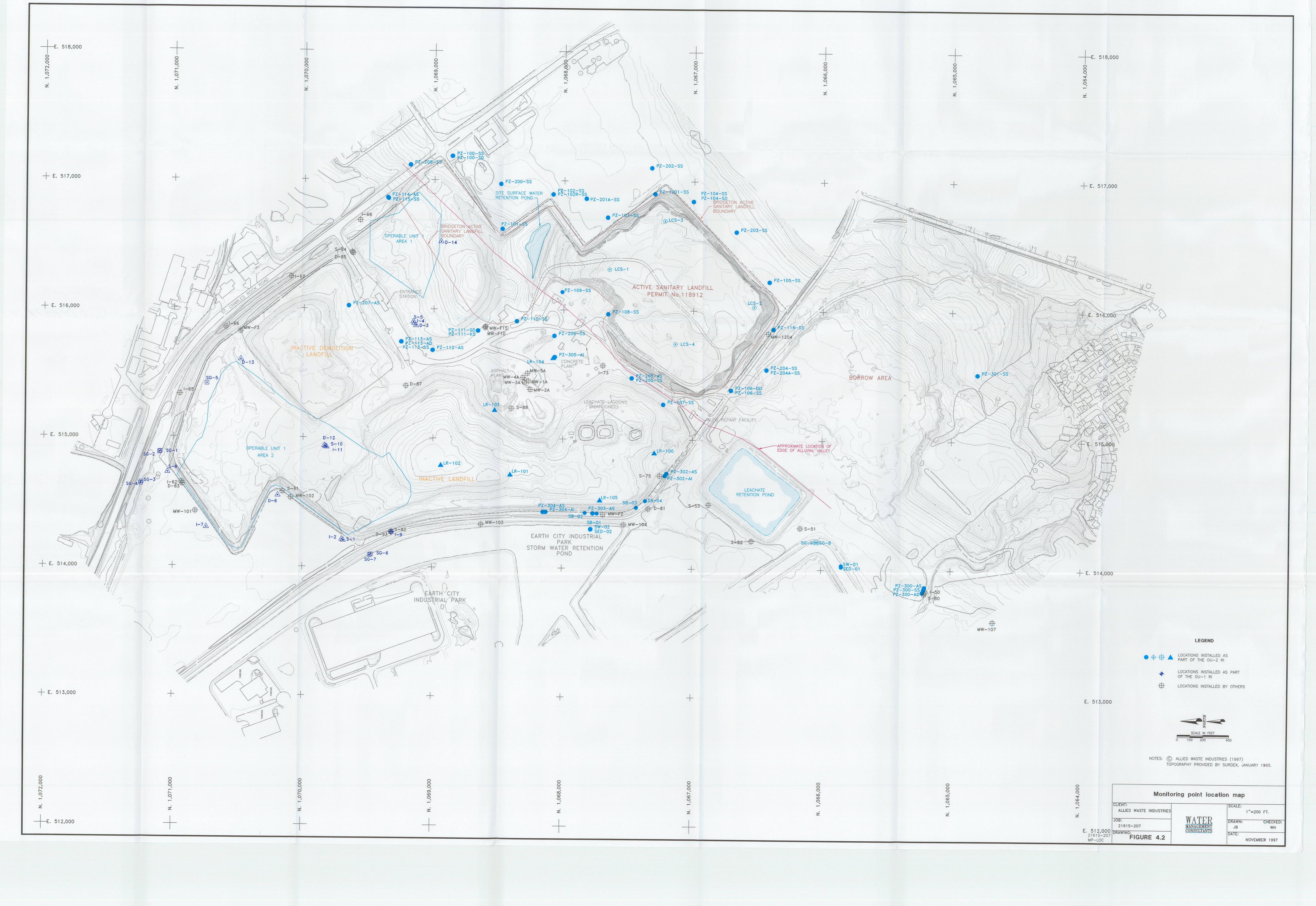


Table 4.1 Drilling water analytical results

Parameter group	Parameter	Result
		(mg/l)
VOC	Chloroform	0.005
Metals	Barium	0.023
	Calcium	24.4
	Iron	2.72
	Magnesium	11.8
	Manganese	0.037
	Sodium	20.8
Conventionals	Hardness	98
	Total dissolved solids	250
	Chloride	19
	Fluoride	1
	Nitrate-Nitrite	1.4
	Phosphorous	0.10
	TOC	3
	Sulfide	3
	Ammonia	1
	Sulfate	85
	COD	28

#### 4.3 Groundwater sampling and analysis procedures

Two groundwater quality sampling rounds were conducted as part of the West Lake Landfill OU-2 RI. The first sampling round began in February 1997 and extended into March 1997. The second sampling round began in May 1997 and extended into June 1997. An additional, off-schedule groundwater sampling event occurred in December 1995. The off-schedule sampling event was needed to allow collection of background groundwater quality data from piezometers PZ-300-AS, PZ-700-AD, and PZ-300-SS, plus wells I-50, and S-80. Property development activities required that these locations be decommissioned early in the RI.

Groundwater sampling was conducted by first collecting water levels in the piezometers and wells. After collection of water levels, wells were purged using a Grundfos Redi-Flo II pump. Disposable polyethylene tubing was used to reduce the potential for cross-contamination. Field parameters pH, temperature, and conductivity were collected during purging. Field parameters were considered stabilized if the pH varied by less than about 0.1 pH unit, temperature varied less than approximately 1 degree Fahrenheit, and conductivity varied by less than 10% between readings. The turbidity of the water was also monitored. Purging forms are included in Appendix B.

Purging was intended to continue until at least three casing volumes had been removed from the piezometer/well. Piezometers/Wells that purged dry with the pump were subsequently bailed dry with disposable bailers. Pjezometers/Wells that purged dry were allowed to recover and were sampled. Field parameters did not always stabilize prior to sampling in wells that purged dry. Piezometers/Wells that did not purge dry were sampled using the pump after the removal of three casing volumes and field parameter stabilization. Pump flow rate was maintained at approximately 200 ml/min to 600 ml/min during sampling.

The disposable polyethylene tubing was discarded after each piezometer/well was sampled. The pump was decontaminated between piezometers/wells by scrubbing the electric cable and pump casing with Liquinox detergent, rinsing with tap water, and a final rinse with laboratory-grade deionized water. In addition, the interior of the pump was decontaminated by first pumping a Liquinox/water mixture through the pump, followed by pumping tap water, then pumping laboratory grade deionized water. The pump was allowed to dry and was covered in plastic during transport to the next piezometer/well.

Piezometers/Wells that purged dry were allowed to recover until a sufficient volume of water had returned to the well to allow collection of at least a suite of compounds. In selected instances when water level recovery was extremely slow due to very low formational hydraulic conductivity, it was necessary to collect a particular sample suite (eg, semi-volatile organics), allow additional recovery, then collect another sample suite. This process was continued until all sample suites had been collected. Slow recovery piezometers/wells were sampled using disposable bailers, which were slowly lowered and raised to minimize agitation of the water. A low-flow sampling port was attached to the bailer to minimize aeration during transfer to the sample containers. New, clean rope was used in each well.

Samples were placed in laboratory supplied, pre-preserved containers. The sample containers were shipped to the appropriate laboratory under chain-of-custody. Groundwater samples collected in the February and May 1997 sampling events were analyzed for the constituents listed in Table 4.2. Groundwater samples collected in the December 1995 off-schedule sampling event were analyzed for major ions (calcium, potassium, magnesium, sodium, chloride, sulfate, bicarbonate as alkalinity), nitrate/nitrite, chemical oxygen demand, and radionuclides (gross alpha, gross beta, radium-226, radium-228, uranium-238, uranium-235/236, uranium-234, thorium-232, thorium-230, and thorium-228). Off-schedule radionuclide groundwater samples were collected as both filtered (dissolved) using a 0.45 micron filter and as unfiltered (total). Metal and conventional parameters were collected as unfiltered (total).

Off-schedule groundwater samples were analyzed by Quanterra Laboratory. February and May 1997 non-radiological analyses were performed by PACE Analytical Services, Inc. Radiological analyses for the February and May 1997 groundwater samples were performed by Southwest Laboratory of Oklahoma. In addition to analyses performed by these two primary laboratories, split samples were analyzed by TriMatrix Laboratories, Inc. (non-radiological) and Paragon Analytics, Inc. (radiological). Use of primary and split laboratories provides relevant quality assurance results, as discussed in Section 10.

Table 4.2 Liquid analyte list

Metals	Radionuclides	VOCs (continued)		
Antimony, Total and Dissolved	Gross Alpha, Total and Dissolved	Methyl isobutyl ketone (4-Methyl-2-pentanone)		
Arsenic, Total and Dissolved	Gross Beta, Total and Dissolved	Methylene bromide (Dibromomethane)		
Barium, Total and Dissolved	Radium-226, Total and Dissolved	Methylene chloride (Dichloromethane)		
Beryllium, Total and Dissolved	Thorium-230, Total and Dissolved	Styrene		
Boron, Total and Dissolved	Uranium-234, 235, and 238, Total and Dissolved	1,1,1,2-Tetrachloromethane		
Cadmium, Total and Dissolved		1,1,2,2-Tetrachloroethane		
Calcium, Total and Dissolved	Volatile Organic Compounds (VOCs)	Tetrachloroethene		
Chromium, Total and Dissolved	Acetone	Toluene		
Cobalt, Total and Dissolved	Acrylonitrile	1,1,1-Trichloroethane		
Copper, Total and Dissolved	Benzene	1,1,2-Trichloroethane		
Iron, Total and Dissolved	Bromochloromethane	Trichloroethene		
Lead, Total and Dissolved	Bromodichloromethane	Trichlorofluoromethane		
Magnesium, Total and Dissolved	Bromoform (Tribromomethane)	1,2,4-Trichlorobenzene		
Manganese, Total and Dissolved	Bromomethane (Methyl bromide)	1,2,3-Trichloropropane		
Mercury, Total and Dissolved	Carbon disulfide	Vinyl acetate		
Nickel, Total and Dissolved	Carbon tetrachloride	Vinyl chloride		
Selenium, Total and Dissolved	Chlorobenzene	Xylenes		
Silver, Total and Dissolved	Chloroethane	•		
Sodium, Total and Dissolved	Chloroform (Trichloromethane)	Semivolatile Organic Compounds (SVOCs)		
Thallium, Total and Dissolved	Chloromethane (Methyl chloride)	Acenaphthene		
Vanadium, Total and Dissolved	1,2-Dibromo-3-chloropropane	Acenaphthylene		
Zinc, Total and Dissolved	Dibromochloromethane (Chlorodibromomethane)	Anthracene		
	1,2-Dibromoethane (Ethylene dibromide)	Benzo(a)anthracene		
General Parameters	trans-1,4-Dichloro-2-butene	Benzo(a)pyrene		
Ammonia as N	1,2-Dichlorobenzene (o-DCB)	Benzo(b)fluoranthene		
Chemical Oxygen Demand (COD)	1,3-Dichlorobenzene (m-DCB)	Benzo(ghi)perylene		
Chloride	1,4-Dichlorobenzene (p-DCB)	Benzo(k)fluoranthene		
Cyanide, Total	1,1-Dichloroethane	4-Bromophenyl phenyl ether		
Fluoride	1,2-Dichloroethane	Butyl benzyl phthalate		
Hardness, Total (Calculated)	1,1-Dichloroethene	Carbazole		
Nitrate/Nitrite	1,2-cis-Dichloroethene	p-Chloro-m-cresol (4-Chloro-3-methylphenol)		
Phosphorous, Total	1,2-trans-Dichloroethene	4-Chloroaniline		
Sulfate as SO4	1,2-Dichloropropane	bis(2-Chloroethoxy)methane		
Sulfide	1,3-cis-Dichloropropene	bis(2-Chloroethyl)ether		
Total Petroleum Hydrocarbons	1,3-trans-Dichloropropene	bis(2-Chloroisopropyl)ether		
Total Dissolved Solids (TDS)	Ethylbenzene	2-Chloronaphthalene		
Total Organic Carbon (TOC)	2-Hexanone	2-Chlorophenol		
	Methyl ethyl ketone (2-Butanone)	4-Chlorophenyl phenyl ether		
	Methyl iodide (iodomethane)	. Sind opinony phony outs.		

Table 4.2 Liquid analyte list (continued)

SVOCs (continued)	SVOCs (continued)	PCBs (continued)
Chrysene	Naphthalene	alpha-Chlordane
m-Cresol (3-Methylphenol)	2-Nitroaniline	gamma-Chlordane
o-Cresol (2-Methylphenol)	3-Niroaniline	4,4'-DDD
p-Cresol (4-Methylphenol)	4-Nitroaniline	4,4'-DDE
Dibenzo(a,h)anthracene	Nitrobenzene	4,4'-DDT
Dibenzofuran	2-Nitrophenol	Dieldrin
3,3-Dichlorobenzidine	4-Nitrophenol	Endosulfan I
2,4-Dichlorophenol	N-Nitrosodi-n-propylamine	Endosulfan II
Diethyl phthalate	N-Nitrosodiphenylamine	Endosulfan sulfate
Dimethyl phthalate	Pentachlorophenol	Endrin
2,4-Dimethylphenol	Phenanthrene	Endrin aldehyde
Di-n-butyl phthalate	Phenol	Endrin ketone
2,4-Dinitrophenol	Pyrene	Heptachlor
2,4-Dinitrotoluene	2,4,5-Trichlorophenol	Heptachlor epoxide
2,6-Dinitrotoluene	2,4,6-Trichlorophenol	Methoxychlor
4,6-Dinitro-o-cresol		Toxaphene
bis(2-Ethylhexyl) phthalate	Pesticides and Polychlorinated Bipherryls (PCBs)	Aroclor-1016
Fluoranthene	Aldrin	Aroclor-1221
Fluorene	alpha-BHC	Aroclor-1232
Hexachlorobenzene	beta-BHC	Aroclor-1242
Hexachlorobutadiene	delta-BHC	Aroclor-1248
Hexachlorocyclopentadiene	gamma-BHC (Lindane)	Aroclor-1254
Hexachloroethane		Aroclor-1260
Indeno(1,2,3-cd)pyrene		
Isophorone		
2-Methylnaphthalene		

#### 4.4 Background groundwater quality

#### 4.4.1 Bedrock background groundwater quality

Background bedrock groundwater quality data are provided by piezometers PZ-300-SS, PZ-301-SS, and PZ-204A-SS. Piezometers PZ-300-SS and PZ-301-SS were installed approximately 2,000 ft south of OU-2. Piezometer PZ-204A-SS was installed approximately 200 ft south of OU-2.

Tables 4.3 and 4.4 list the reported concentrations for the off-schedule background bedrock groundwater samples.

Table 4.3 Background bedrock groundwater quality results (metal and conventional parameters)

December 1995 sampling event

Parameter	GW-300-SS		
	(mg/l)		
Calcium	73.9		
Potassium	<5		
Magnesium	56.4		
Sodium	10.7		
Chloride	6		
Sulfate	20		
Bicarbonate as alkalinity	500		
Nitrate/Nitrite	<0.1		
Chemical oxygen demand	50		

Table 4.4 Background bedrock groundwater radionuclide results (pCi/l)

Parameter	GW-300-SS	GW-300-SS
	(unfiltered)	(filtered)
Gross alpha	3.51 ± 2.69	<3.32
Gross beta	$4.37 \pm 2.25$	<3.72
Radium-226	$0.78 \pm 0.09$	$0.60 \pm 0.08$
Radium-228	$0.39 \pm 0.37$	<0.43
Uranium-238	$0.25 \pm 0.13$	$0.50 \pm 0.20$
Uranium-235/236	$0.32 \pm 0.17$	0.13 ± 0.11
Uranium-234	$0.80 \pm 0.26$	$0.89 \pm 0.28$
Thorium-232	<0.092	<0.11
Thorium-230	$0.84 \pm 0.29$	$0.29 \pm 0.17$
Thorium-228	<0.13	<0.15

No volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs were detected in background bedrock piezometers sampled during the two scheduled sampling rounds. Selected metals were detected, as were selected radionuclides. The detected metals and radionuclides are presented in Table 4.5.

Table 4.5 Background bedrock groundwater quality summary PZ-300-SS, PZ-301-SS, PZ-204A-SS

Parameter	Range of background
	concentrations
	(mg/l)
Metals	
Antimony (Dissolved)	<0.003 to 0.008
Antimony (Total)	<0.002 to 0.009
Arsenic (Dissolved)	<0.002 to 0.008
Arsenic (Total)	<0.002 to 0.007
Barium (Dissolved)	0.022 to 0.079
Barium (Total)	0.037 to 0.1
Beryllium (Dissolved)	<0.001 to <0.001
Beryllium (Total)	<0.001 to <0.001
Boron (Dissolved)	<0.1 to 0.636
Boron (Total)	<0.1 to 0.8
Cadmium (Dissolved)	<0.005 to <0.005
Cadmium (Total)	<0.005 to <0.005
Calcium (Dissolved)	40.1 to 66.9
Calcium (Total)	41.0 to 75.4
Chromium (Dissolved)	<0.01 to <0.01
Chromium (Total)	<0.01 to <0.01
Cobalt (Dissolved)	<0.02 to <0.02
Cobalt (Total)	<0.02 to <0.02
Copper (Dissolved)	<0.02 to <0.02
Copper (Total)	<0.02 to <0.02
Iron (Dissolved)	<0.04 to 0.665
Iron (Total)	<0.04 to 1.02
Lead (Dissolved)	<0.002 to <0.002
Lead (Total)	<0.002 to 0.003
Magnesium (Dissolved)	25.1 to 37.6
Magnesium (Total)	25.4 to 56.4
Manganese (Dissolved)	0.045 to 0.063
Manganese (Total)	0.045 to 0.064
Mercury (Dissolved)	<0.0002 to <0.0002
Mercury (Total)	<0.0002 to <0.0002
Nickel (Dissolved)	<0.040 to <0.040
Nickel (Total)	<0.040 to <0.040

Table 4.5 Background bedrock groundwater quality summary PZ-300-SS, PZ-301-SS, PZ-204A-SS (continued)

Parameter	Range of background			
	concentrations			
	(mg/l)			
Metals (continued)				
Selenium (Dissolved)	<0.002 to <0.002			
Selenium (Total)	<0.002 to <0.002			
Silver (Dissolved)	<0.010 to <0.010			
Silver (Total)	<0.010 to <0.010			
Sodium (Dissolved)	30.1 to 153			
Sodium (Total)	28.1 to 154			
Thallium (Dissolved)	<0.002 to <0.002			
Thallium (Total)	<0.002 to <0.002			
Vanadium (Dissolved)	<0.010 to <0.010			
Vanadium (Total)	<0.010 to <0.010			
Zinc (Dissolved)	<0.030 to <0.030			
Zinc (Total)	<0.030 to 0.133			
Conventionals				
Ammonia as N	<0.1 to 0.2			
Chemical Oxygen Demand	<15 to 50			
Chloride	4 to 7			
Cyanide, Total	<0.010 to <0.010			
Fluoride	0.43 to 1.8			
Hardness, Total	220 to 360			
Nitrate/Nitrite	<0.1 to 0.2			
Phosphorus, Total	0.04 to 1.5			
Sulfate as SO4	20 to 73			
Sulfide as S	<1 to 1			
Total Dissolved Solids	432 to 640			
Total Organic Carbon	<1 to 7			
Radionuclides				
Gross Alpha (Dissolved)	<3.32 to 17.9+/-5.24			
Gross Alpha (Total)	3.51+/-2.69 to 28.8+/-7.21			
Gross Beta (Dissolved)	<3.72 to 9.28+/-3.86			
Gross Beta (Total)	4.37+/-2.25 to 20.5+/-4.37			
Radium-226 (Dissolved)	<0.43 to 1.42+/-0.563			
Radium-226 (Total)	0.78+/-0.09 to 3.33+/-0.769			
Uranium-234 (Dissolved)	0.89+/-0.28 to 8.2+/-1.37			
Uranium-234 (Total)	0.80+/-0.26 to 9.78+/-1.81			
Uranium-235/236 (Dissolved)	<0.141 to 0.769+/-0.449			
Uranium-235/236 (Total)	<0.169 to 0.516+/-0.35			
Uranium-238 (Dissolved)	0.50+/-0.20 to 3.36+/-0.888			
Uranium-238 (Total) Thorium-230 (Dissolved)	0.25+/-0.13 to 4.55+/-1.25			
Thorium-230 (Dissolved) Thorium-230 (Total)	<0.502 to 0.29+/-0.17 <0.736 to 0.84+/-0.29			
THORIGIN-230 (Total)	<u> </u>			

Note: Radionuclide results presented in pCi/l

#### 4.4.2 Alluvial background groundwater quality

Background alluvial groundwater quality data are provided by wells MW-107, S-80 and I-50, plus piezometer PZ-300-AS. Wells S-80 and I-50, plus piezometer PZ-300-AS, were included in the December 1995 off-schedule sampling event. Tables 4.6 and 4.7 list the reported concentrations of the off-schedule background alluvial groundwater samples.

No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were detected in MW-107 in either of the two scheduled sampling rounds. Selected metals and inorganic compounds were detected, as shown in Table 4.8.

Table 4.6 Background alluvial groundwater quality results (metals and conventional parameters)

December 1995 sampling event

Parameter	GW-300-AS	GW-300-AD	GW-S-80	GW-1-50	GW-MW-107
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)_
Calcium	142	176	151	159	131
Potassium	<5	6.1	5.4	<5	<5
Magnesium	41.6	61.1	51.5	57.9	52.6
Sodium	73.0	38.6	66.1	35.4	35.8
Chloride	210	150	250	160	130
Sulfate	110	100	67	26	70
Bicarbonate as alkalinity	280	460	330	460	400
Nitrate/Nitrite	<0.1	<0.1	<0.1	<0.1	<0.1
Chemical oxygen demand	<20	<20	<20	<20	40

Table 4.7 Background alluvial groundwater radionuclide results

Well/	Gross Alpha	Gross Beta	Ra-226	Ra-228	U-238	U-235/236	U-234	Th-232	Th-230	Th-228
Piezometer				<del></del>						_ <del></del>
GW-300-AS (unfiltered)	<3.53	9.34 ± 1.64	0.31 ± 0.05	<0.55	$0.57 \pm 0.20$	<0.17	0.74 ± 0.23	$0.22 \pm 0.14$	0.51 ± 0.21	.<0.14
GW-300-AS (filtered)	<4.18	4.08 ± 2.28	$0.20 \pm 0.003$	<0.32	$0.55 \pm 0.18$	<0.13	0.58 ± 0.19	<0.21	0.26 ± 0.18	<0.20
GW-300-AD (unfiltered)	5.49 ± 3.51	8.47 ± 2.43	$0.51 \pm 0.07$	$1.00 \pm 0.54$	$0.26 \pm 0.13$	<0.13	0.32 ± 0.15	0.13 ± 0.11	$0.83 \pm 0.30$	0.18 ± 0.13
GW-300-AD (filtered)	<4.05	<4.07	$0.35 \pm 0.05$	<0.41	0.17 ± 0.09	<0.10	$0.40 \pm 0.15$	0.12 ± 0.08	0.50 ± 0.19	<0.10
GW-S-80 (unfiltered)	56.1 ± 9.5	53.1 ± 6.2	$0.44 \pm 0.06$	<0.65	$1.19 \pm 0.35$	0.27 ± 0.17	0.99 ± 0.31	$0.86 \pm 0.28$	1.48 ± 0.40	0.85 ± 0.28
GW-S-80 (filtered)	<7.02	<3.94	0.19 ± 0.04	<0.42	$0.63 \pm 0.21$	0.16 ± 0.11	0.88 ± 0.26	<0.11	0.31 ± 0.16	<0.13
GW-1-50 (unfiltered)	<4.32	5.12 ± 2.52	$0.42 \pm 0.06$	<0.40	0.15 ± 0.10	0.18 ± 0.12	0.43 ± 0.18	0.17 ± 0.12	$1.00 \pm 0.33$	<0.12
GW-1-50 (filtered)	<4.06	6.02 ± 3.00	$0.29 \pm 0.04$	<0.48	<0.097	<0.14	$0.25 \pm 0.13$	0.21 ± 0.13	$0.93 \pm 0.30$	<0.11
GW-MW-107 (unfiltered)	<4.64	4.38 ± 2.49	<0.066	<0.68	$0.26 \pm 0.13$	<0.09	0.43 ± 0.17	0.33 ± 0.17	0.29 ± 0.16	$0.26 \pm 0.15$
GW-MW-107 (filtered)	<3.03	<3.96	0.069 ± 0.029	<0.39	0.36 ± 0.16	<0.10	0.39 ± 0.17	<0.085	0.27 ± 0.15	<0.11

Notes:

All results in pCi/l

Samples collected in December 1995

Table 4.8 Background alluvial groundwater quality summary monitoring wells MW-107, S-80, and 1-50 and piezometers PZ-300-AS and PZ-300-AD

Parameter	Range of background
rarameter	concentrations
	(mg/l)
Metals	
Antimony (Dissolved)	<0.003 to <0.003
Antimony (Total)	<0.003 to <0.003
Arsenic (Dissolved)	0.004 to 0.004
Arsenic (Total)	0.004 to 0.004
Barium (Dissolved)	0.152 to 0.178
Barium (Total)	0.152 to 0.182
Beryllium (Dissolved)	<0.001 to <0.001
Beryllium (Total)	<0.001 to <0.001
Boron (Dissolved)	<0.1 to <0.1
Boron (Total)	<0.1 to <0.1
Cadmium (Dissolved)	<0.005 to <0.005
Cadmium (Total)	<0.005 to <0.005
Calcium (Dissolved)	158 to 159
Calcium (Total)	131 to 176
Chromium (Dissolved)	<0.010 to <0.010
Chromium (Total)	<0.010 to 0.011
Cobalt (Dissolved)	<0.020 to <0.020
Cobalt (Total)	<0.020 to <0.020
Copper (Dissolved)	<0.020 to <0.020
Copper (Total)	<0.020 to <0.020
Iron (Dissolved)	3.33 to 4.06
Iron (Total)	1.98 to 2.83
Lead (Dissolved)	<0.002 to <0.002
Lead (Total)	<0.002 to <0.002
Magnesium (Dissolved)	56.4 to 58.0
Magnesium (Dissolved)  Magnesium (Total)	41.6 to 57.8
Manganese (Dissolved)	3.09 to 3.32
Manganese (Total)	3.05 to 3.14
= : :	
Mercury (Dissolved)	<0.0002 to <0.0002 <0.0002 to <0.0002
Mercury (Total) Nickel (Dissolved)	
	<0.04 to <0.04
Nickel (Total)	<0.04 to <0.04
Selenium (Dissolved)	<0.002 to <0.002
Selenium (Total)	<0.002 to <0.002
Silver (Dissolved)	<0.010 to <0.010
Silver (Total)	<0.010 to <0.010
Sodium (Dissolved)	43.4 to 44.9
Sodium (Total)	35.4 to 73.0
Thallium (Dissolved)	<0.002 to <0.002
Thallium (Total)	<0.002 to <0.002
Vanadium (Dissolved)	<0.010 to <0.010
Vanadium (Total)	<0.010 to <0.010
Zinc (Dissolved)	<0.030 to <0.030
Zinc (Total)	<0.030 to <0.030

Table 4.8 Background alluvial groundwater quality summary monitoring wells MW-107, S-80, and 1-50 and piezometers PZ-300-AS and PZ-300-AD (continued)

Parameter	Range of background
	concentrations
	(mg/l)
Conventionals	
Ammonia as N	0.4 to 0.4
Chemical Oxygen Demand	<15 to 40
Chloride	130 to 215
Cyanide, Total	<0.010 to <0.010
Fluoride	0.27 to 0.36
Hardness, Total	660 to 700
Nitrate/Nitrite	<0.1 to <0.1
Phosphorus, Total	0.39 to 0.63
Sulfate as SO4	62 to 110
Sulfide as S	<1 to <1
Total Dissolved Solids	933 to 940
Total Organic Carbon	2 to 3
Radionuclides	
Gross Alpha (Dissolved)	<3.03 to <8.19
Gross Alpha (Total)	<3.53 to 56.1+/-9.5
Gross Beta (Dissolved)	<3.94 to 6.02+/-3.00
Gross Beta (Total)	4.38+/-2.49 to 53.1+/-6.2
Radium-226 (Dissolved)	0.069+/-0.029 to 0.35+/-0.05
Radium-226 (Total)	<0.066 to 0.51+/-0.07
Uranium-234 (Dissolved)	0.25+/-0.13 to 0.88+/-0.26
Uranium-234 (Total)	0.32+/-0.15 to 0.99+/-0.31
Uranium-235/236 (Dissolved)	<0.10 to 0.16+/-0.11
Uranium-235/236 (Total)	<0.09 to 0.27+/-0.17
Uranium-238 (Dissolved)	<0.097 to 0.63+/-0.21
Uranium-238 (Total)	<0.258 to 1.19+/-0.35
Thorium-230 (Dissolved)	<0.627 to 0.93+/-0.30
Thorium-230 (Total)	<0.415 to 1.48+/-0.40

Note: Radionuclide results presented in pCi/l

#### 4.5 Detection monitoring

In the following discussions, detection monitoring results are representative of groundwater sampling results from piezometers and wells installed adjacent to the OU-2 boundary. Many of the sampling points are upgradient of the site due to the inward hydraulic gradient established by the active sanitary landfill leachate collection system. Others are internal to the site and are hydraulically downgradient of selected on-site facilities yet upgradient of the active solid waste landfill. Others, particularly the alluvial piezometers and wells west of the inactive landfill, are hydraulically downgradient of the site. Detection monitoring results are considered to be all groundwater samples that were not collected from background monitoring locations described in Section 4.4 above.

#### 4.5.1 St. Louis/Upper Salem hydrogeologic unit

Thirteen piezometers were used to collect groundwater samples from the St. Louis/Upper Salem hydrogeologic unit near OU-2. These are listed below:

PZ-100-SS	PZ-204A-SS
PZ-102R-SS	PZ-206-SS
PZ-1201-SS	PZ-113-SS
PZ-104-SS	PZ-208-SS
PZ-106-SS	PZ-300-SS
PZ-110-SS	PZ-301-SS
PZ-201A-SS	

Piezometer PZ-300-SS was included in the off-schedule sampling event discussed in Section 4.4, and was decommissioned prior to the two scheduled RI sampling rounds. Background data provided by PZ-204A-SS, PZ-300-SS and PZ-301-SS were discussed in Section 4.4.

Volatile organic compounds were detected only sporadically in St. Louis/Upper Salem piezometers, and were detected at low concentrations. The detected VOCs were limited to acetone; benzene; 1,2-cis-dichloroethene; and total xylenes. Only five piezometers exhibited one or more detectable VOCs. These included PZ-102R-SS, PZ-104-SS, PZ-106-SS, PZ-1201-SS, and PZ-201A-SS. None of the VOCs was detected in both sampling rounds. Furthermore, no single piezometer exhibited detectable concentrations of VOCs in both sampling rounds. All of the detections were at or near the reporting limit.

Acetone was detected in only one St. Louis/Upper Salem piezometer, and in only one of the two rounds. Acetone was detected at the laboratory reporting limit of 0.005 mg/l in PZ-1201-SS during the February sampling round, but was not detected in any St. Louis/Upper Salem piezometer during the second sampling round.

Benzene was detected at a concentration of 0.011 mg/l in PZ-1201-SS in the first sampling round compared to a reporting limit of 0.002 mg/l, but was not detected in the second sampling round. Benzene was detected in PZ-102R-SS, and PZ-106-SS during the second sampling round at low concentrations of 0.0028 mg/l and 0.0031 mg/l, respectively, but was not detected in these piezometers during the first round.

Only two additional samples exhibited an organic result above reporting limits. Cis-1,2-dichloroethene was reported at 0.0024 mg/l in PZ-110-SS during round two, but was not detected during the first sampling round. Total xylenes were detected at 0.003 mg/l, 0.002 mg/l, and 0.002 mg/l in piezometers PZ-102R-SS, PZ-104-SS, and PZ-201A-SS, respectively, during the second round, compared to a reporting limit of 0.002 mg/l. Total xylenes were not detected in the first sampling round.

No semi-volatile organic compounds were detected in the St. Louis/Upper Salem piezometers in either sampling round.

One pesticide was detected in one piezometer, in only one of the two sampling rounds. Gamma-chlordane was detected at a concentration of 0.000051 mg/l in the first sampling round compared to a reporting limit of 0.00005 mg/l. Gamma-chlordane was not detected in the second sampling round.

No PCBs were detected in either sampling round.

Table 4.9 compares the range of metal concentrations, conventional concentrations and radionuclide activities in the St. Louis/Upper Salem piezometers to the background range. Based on the data presented in Table 4.9, many of the metals and conventionals were undetected in both the background and detection piezometers. These include beryllium, cadmium, total chromium, cobalt, dissolved copper, dissolved lead, mercury, silver, thallium, vanadium, and cyanide (total).

Six piezometers account for all of the maximum metal and conventional concentrations in the detection wells. These include PZ-1201-SS, PZ-102R-SS, PZ-110-SS, PZ-110-SS, PZ-110-SS, PZ-110-SS, PZ-110-SS, PZ-110-SS, and PZ-201A-SS. Piezometers PZ-102R-SS, PZ-100-SS, and PZ-201A-SS are located on the perimeter of the OU-2 area, in locations which have been shown to be consistently upgradient of OU-2. Maximum metal and conventional concentrations in these locations therefore represent natural variability common to metal and conventional parameters. Piezometer PZ-1201-SS is located immediately adjacent to the northeastern corner of the active landfill area. PZ-1201-SS exhibited maximum concentrations of dissolved antimony, nitrate/nitrite and phosphorus (total). Maximum detection values should be compared to background values to determine potential groundwater quality differences. As shown in Table 4.9, the maximum concentrations of the parameters in PZ-1201-SS are approximately equivalent to background concentrations. Therefore, the parameters which exhibited their maximum concentrations in PZ-1201-SS represent background, unimpacted groundwater quality.

Piezometers PZ-110-SS and PZ-113-SS are located in areas internal to the site. Twenty-four of the 36 maximum metal and conventional concentrations were detected in either PZ-110-SS or PZ-113-SS. Given the presence of the inactive landfill, demolition landfill, OU-1 Area 1, OU-1 Area 2, previously-filled active landfill area, asphalt plant, and concrete plant near PZ-110-SS and PZ-113-SS, the presence of metals and conventional compounds in these two piezometers is reasonable.

Split laboratory results are consistent with the prime laboratory results. Section 10 discusses data comparability in more detail.

Table 4.9 Comparison of St. Louis/Upper Salem detection results to background bedrock groundwater quality

Parameter	". Range of	Range of detection results (mg/l)	Piezometer exhibiting
	background concentrations		the maximum detection concentration
	(mg/l)		
Metals			
Antimony (Dissolved)	<0.003 to 0.008	<0.003 to 0.004	PZ-1201-SS
Antimony (Total)	<0.002 to 0.009	<0.003 to 0.007	PZ-102R-SS
Arsenic (Dissolved)	<0.002 to 0.008	<0.002 to 0.007	PZ-113-SS
Arsenic (Total)	0.002 to 0.007	<0.002 to 0.006	PZ-113-SS
Barium (Dissolved)	0.022 to 0.079	0.033 to 0.251	PZ-110-SS
Barium (Total)	0.037 to 0.1	0.054 to 0.252	PZ-110-SS
Beryllium (Dissolved)	<0.001 to <0.001	<0.001 to <0.001	
Beryllium (Total)	<0.001 to <0.001	<0.001 to <0.001	
Boron (Dissolved)	<0.1 to 0.636	<0.1 to 0.282	PZ-110-SS
Boron (Total)	<0.1 to 0.80	<0.1 to 0.30	PZ-110-SS
Cadmium (Dissolved)	<0.005 to <0.005	<0.005 to <0.005	
Cadmium (Total)	<0.005 to <0.005	<0.005 to <0.005	
Calcium (Dissolved)	40.1 to 66.9	49.6 to 219	PZ-110-SS
Calcium (Total)	41.0 to 75.4	60 to 214	PZ-110-SS
Chromium (Dissolved)	<0.01 to <0.01	0.01 to 0.016	PZ-113-SS
Chromium (Total)	<0.01 to <0.01	<0.01 to <0.01	
Cobalt (Dissolved)	<0.02 to <0.02	<0.02 to <0.02	
Cobalt (Total)	<0.02 to <0.02	<0.02 to <0.02	
Copper (Dissolved)	<0.02 to <0.02	<0.02 to <0.02	
Copper (Total)	<0.02 to <0.02	<0.02 to 0.045	•
Iron (Dissolved)	<0.04 to 0.665	<0.04 to 4.24	PZ-110-SS
Iron (Total)	<0.04 to 1.02	<0.04 to 5.87	PZ-110-SS
Lead (Dissolved)	<0.002 to <0.002	<0.002 to <0.002	
Lead (Total)	<0.002 to 0.003	<0.002 to 0.008	
Magnesium (Dissolved)	25.1 to 37.6	26.3 to 80.0	PZ-110-SS
Magnesium (Total)	25.4 to 56.4	29.1 to 81	PZ-110-SS
Manganese (Dissolved)	0.045 to 0.063	<0.01 to 0.375	PZ-201A-SS
Manganese (Total)	0.045 to 0.064	0.017 to 0.528	PZ-201A-SS
Mercury (Dissolved)	<0.0002 to <0.0002	<0.0002 to <0.0002	
Mercury (Total)	<0.0002 to <0.0002	<0.0002 to <0.0002	
Nickel (Dissolved)	<0.040 to <0.040	<0.04 to 0.048	PZ-110-SS
Nickel (Total)	<0.040 to <0.040	<0.04 to 0.055	PZ-110-SS
Selenium (Dissolved)	<0.002 to <0.002	<0.002 to 0.003	PZ-102R-SS
Selenium (Total)	<0.002 to <0.002	<0.002 to 0.003	PZ-102R-SS
Silver (Dissolved)	<0.010 to <0.010	<0.010 to <0.010	
Silver (Total)	<0.010 to <0.010	<0.010 to <0.010	
Sodium (Dissolved)	30.1 to 153	11 to 114	PZ-110-SS
Sodium (Total)	28.1 to 154	11 to 115	PZ-110-SS
Thallium (Dissolved)	<0.002 to <0.002	<0.002 to <0.002	
Thallium (Total)	<0.002 to <0.002	<0.002 to <0.002	
Vanadium (Dissolved)	<0.010 to <0.010	<0.010 to <0.010	
Vanadium (Total)	<0.010 to <0.010	<0.010 to <0.010	
Zinc (Dissolved)	<0.030 to <0.030	<0.030 to 0.044	PZ-110-SS
Zinc (Total)	<0.030 to 0.133	<0.030 to 0.227	PZ-110-SS

Table 4.9 Comparison of St. Louis/Upper Salem detection results to background bedrock groundwater quality (continued)

Parameter	Range of background concentrations	Range of detection results	Piezometer exhibiting the maximum detection concentration
	(mg/l)	(mg/l)	
Conventionals			
Ammonia as N	<0.1 to 0.2	<0.1 to 0.8	PZ-100-SS
Chemical Oxygen Demand	<15 to 50	<15 to 81	PZ-110-SS
Chloride	4 to 7	<3 to 215	PZ-110-SS
Cyanide, Total	<0.010 to <0.010	<0.010 to <0.010	
Fluoride	0.43 to 1.8	0.49 to 2.7	PZ-113-SS
Hardness, Total	220 to 360	290 to 900	PZ-110-SS
Nitrate/Nitrite	<0.1 to 0.2	<0.1 to 0.2	PZ-1201-SS
Phosphorus, Total	0.04 to 1.5	0.06 to 1.6	PZ-1201-SS
Sulfate as SO4	20 to 73	26 to 141	PZ-102R-SS
Sulfide as S	<1 to 1	<1 to 4.3	PZ-102R-SS
Total Dissolved Solids	432 to 640	364 to 1418	PZ-110-SS
Total Organic Carbon	<1 to 7	<1 to 23	PZ-110-SS
Radionuclides			
Gross Alpha (Dissolved)	<3.32 to 17.9+/-5.24	<2.97 to 17.4+/-5	PZ-100-SS
Gross Alpha (Total)	3.51+/-2.69 to 28.8+/-7.21	<4.61 to 29.3+/-11.9	PZ-1201-SS
Gross Beta (Dissolved)	<3.72 to 9.28+/-3.86	<3.6 to 19+/-2.28	PZ-1201-SS
Gross Beta (Total)	4.37+/-2.25 to 20.5+/-4.37	<4.49 to 35.2+/-10.7	PZ-1201-SS
Radium-226 (Dissolved)	<0.43 to 1.42+/-0.563	<0.412 to 2.53+/-0.733	PZ-106-SS
Radium-226 (Total)	0.78+/-0.09 to 3.33+/-0.769	<0.426 to 6.33+/-1.26	PZ-106-SS
Uranium-234 (Dissolved)	0.89+/-0.28 to 8.2+/-1.37	<0.343 to 12.7+/-1.46	PZ-100-SS
Uranium-234 (Total)	0.80+/-0.26 to 9.78+/-1.81	0.202+/-0.146 to 20+/-1.39	PZ-104-SS
Uranium-235/236 (Dissolved)	<0.141 to 0.769+/-0.449	<0.151 to 1.25+/-0.851	PZ-201A-SS
Uranium-235/236 (Total)	<0.169 to 0.516+/-0.35	<0.123 to 0.746+/-0.418	PZ-100-SS
Uranium-238 (Dissolved)	0.50+/-0.20 to 3.36+/-0.888	<0.151 to 6.27+/-1.2	PZ-100-SS
Uranium-238 (Total)	0.25+/-0.13 to 4.55+/-1.25	<0.134 to 6.39+/-1.15	PZ-100-SS
Thorium-230 (Dissolved)	<0.502 to 0.29+/-0.17	<0.442 to 0.934+/-0.392	PZ-206-SS
Thorium-230 (Total)	<0.736 to 0.84+/-0.29	<0.535 to 2.41+/-1.1	PZ-1201-SS

#### Notes:

Background data from PZ-300-SS, PZ-301-SS, PZ-204A-SS Radionuclide results presented in pCi/l

#### 4.5.2 Deep Salem hydrogeologic unit

Five piezometers/wells were used to monitor groundwater quality in the Deep Salem hydrogeologic unit. These include PZ-100-SD, PZ-104-SD, PZ-106-SD, PZ-111-SD, and MW-1204.

Only one VOC was detected above the reporting limit in either of the sampling rounds, and was detected in only one piezometer. Benzene was detected at a concentration of 0.013 mg/l in PZ-111-SD during the second sampling round, but was not detected in the first sampling round.

No semi-volatile organics, pesticides, or PCBs were detected in the Salem groundwater samples.

Table 4.10 compares the range of metal concentrations, conventional concentrations and radionuclide activities in the Deep Salem piezometers to the background range for the St. Louis/ Upper Salem hydrogeologic unit. No Deep Salem background piezometers were installed as part of the OU-2 RI. Differing depositional history can often result in different metal, conventional, and radionuclide concentrations between two geologic units. Conclusions drawn based on Table 4.10 should take into account the fact that the results are based on two different geologic horizons.

Table 4.10 Comparison of Deep Salem detection results to background bedrock groundwater quality

Parameter	Range of background concentrations (mg/l)	Range of detection results (mg/l)	Piezometer exhibiting the maximum detection concentration
Metals	<u> </u>	· · · · · · · · · · · · · · · · · · ·	
Antimony (Dissolved)	<0.003 to 0.008	<0.003 to <0.003	
Antimony (Total)	<0.002 to 0.009	<0.003 to <0.003	
Arsenic (Dissolved)	<0.002 to 0.008	<0.002 to 0.002	PZ-100-SD
Arsenic (Total)	0.002 to 0.007	<0.002 to 0.002	PZ-100-SD; PZ-106-SD
Barium (Dissolved)	0.022 to 0.079	0.045 to 0.273	PZ-100-SD
Barium (Total)	0.037 to 0.1	0.05 to 0.291	PZ-100-SD
Beryllium (Dissolved)	<0.001 to <0.001	<0.001 to <0.001	
Beryllium (Total)	<0.001 to <0.001	<0.001 to <0.001	
Boron (Dissolved)	<0.1 to 0.636	<0.1 to <0.1	
Boron (Total)	<0.1 to 0.80	<0.1 to <0.1	
Cadmium (Dissolved)	<0.005 to <0.005	<0.005 to <0.005	
Cadmium (Total)	<0.005 to <0.005	<0.005 to <0.005	
Calcium (Dissolved)	40.1 to 66.9	75.8 to 119	PZ-104-SD
Calcium (Total)	41.0 to 75.4	81.2 to 116	PZ-104-SD
Chromium (Dissolved)	<0.01 to <0.01	<0.01 to <0.01	PZ-113-SS
Chromium (Total)	<0.01 to <0.01	<0.01 to <0.01	
Cobalt (Dissolved)	<0.02 to <0.02	<0.02 to <0.02	
Cobalt (Total)	<0.02 to <0.02	<0.02 to <0.02	
Copper (Dissolved)	<0.02 to <0.02	<0.02 to <0.02	
Copper (Total)	<0.02 to <0.02	<0.02 to <0.02	
ron (Dissolved)	<0.04 to 0.665	<0.04 to 0.945	MW-1204
ron (Total)	<0.04 to 1.02	0.119 to 2.09	PZ-100-SD
ead (Dissolved)	<0.002 to <0.002	<0.002 to <0.002	
ead (Total)	<0.002 to 0.003	<0.002 to <0.002	
Magnesium (Dissolved)	25.1 to 37.6	34.0 to 53.9	PZ-111-SD
Magnesium (Total)	25.4 to 56.4	34.3 to 53.4	PZ-111-SD
Manganese (Dissolved)	0.045 to 0.063	0.016 to 0.238	PZ-106-SD
Manganese (Total)	0.045 to 0.064	0.017 to 0.332	PZ-100-SD
Mercury (Dissolved)	<0.0002 to <0.0002	<0.0002 to <0.0002	
flercury (Total)	<0.0002 to <0.0002	<0.0002 to <0.0002	
Nickel (Dissolved)	<0.040 to <0.040	<0.04 to <0.04	
Nickel (Total)	<0.040 to <0.040	<0.04 to <0.04	

Table 4.10 Comparison of Deep Salem detection results to background bedrock groundwater quality (continued)

Parameter	Range of	Range of	Piezometer exhibiting
	background concentrations (mg/l)	detection results (mg/l)	the maximum detection concentration
Metals (continued)	(1119/11)	(mg/.)	ooneentration.
Selenium (Dissolved)	<0.002 to <0.002	<0.002 to <0.002	
Selenium (Total)	<0.002 to <0.002	<0.002 to <0.002	
Silver (Dissolved)	<0.010 to <0.010	<0.010 to <0.010	
Silver (Total)	<0.010 to <0.010	<0.010 to <0.010	
Sodium (Dissolved)	30.1 to 153	11 to 59.9	PZ-106-SD
Sodium (Total)	28.1 to 154	11 to 59.1	PZ-106-SD
Thallium (Dissolved)	<0.002 to <0.002	<0.002 to <0.002	
Thallium (Total)	<0.002 to <0.002	<0.002 to <0.002	
Vanadium (Dissolved)	<0.010 to <0.010	<0.010 to <0.010	
Vanadium (Total)	<0.010 to <0.010	<0.010 to <0.010	
Zinc (Dissolved)	<0.030 to <0.030	<0.03 to 0.053	PZ-111-SD
Zinc (Total)	<0.030 to 0.133	<0.03 to 0.103	PZ-111-SD
Conventionals			
Ammonia as N	<0.1 to 0.2	<0,1 to 0.5	PZ-100-SD; PZ-106-SD
Chemical Oxygen Demand	<15 to 50	<15 to 92	PZ-106-SD
Chloride	4 to 7	<3 to 56	PZ-104-SD
Cyanide, Total	<0.010 to <0.010	<0.01 to <0.01	
Fluoride	0.43 to 1.8	0.77 to 2.4	PZ-1204-SD
Hardness, Total	220 to 360	340 to 500	PZ-104-SD
Nitrate/Nitrite	<0.1 to 0.2	<0.1 to 0.3	PZ-106-SD
Phosphorus, Total	0.04 to 1.5	<0.01 to 0.37	PZ-111-SD
Sulfate as SO4	20 to 73	10 to 120	PZ-106-SD
Sulfide as S	<1 to 1	<1 to 1	PZ-106-SD;
Total Dissolved Solids	432 to 640	340 to 665	PZ-111-SD; MW-1204 PZ-106-SD
Total Organic Carbon	<1 to 7	<1 to 26	PZ-106-SD
Radionuclides			
Gross Alpha (Dissolved)	<3.32 to 17.9+/-5.24	<3.13 to 10.8+/-4.98	PZ-106-SD
Gross Alpha (Total)	3.51+/-2.69 to 28.8+/-7.21	<4.18 to 12.3+/-5.4	PZ-106-SD
Gross Beta (Dissolved)	<3.72 to 9.28+/-3.86	<4.14 to 6.73+/-2.19	PZ-100-SD
Gross Beta (Total)	4.37+/-2.25 to 20.5+/-4.37	<3.56 to 9.53+/-3.61	MW-1204
Radium-226 (Dissolved)	<0.43 to 1.42+/-0.563	<0.706 to 2.38+/-0.729	MW-1204
Radium-226 (Total)	0.78+/-0.09 to 3.33+/-0.769	<0.678 to 2.98+/-0.898	PZ-100-SD
Jranium-234 (Dissolved)	0.89+/-0.28 to 8.2+/-1.37	<0.283 to 2.32+/-0.541	PZ-106-SD
Jranium-234 (Total)	0.80+/-0.26 to 9.78+/-1.81	<0.628 to 15.3+/-1.82	MW-1204
Jranium-235/236 (Dissolved)	<0.141 to 0.769+/-0.449	<0.13 to 0.315+/-0.176	PZ-100-SD
Jranium-235/236 (Total)	<0.169 to 0.516+/-0.35	<0.159 to 0.744+/-0.416	MW-1204
Jranium-238 (Dissolved)	0.50+/-0.20 to 3.36+/-0.888	<0.283 to 2.57+/-1.14	PZ-106-SD
Jranium-238 (Total)	0.25+/-0.13 to 4.55+/-1.25	<0.346 to 6.9+/-1.2	MW-1204
horium-230 (Dissolved)	<0.502 to 0.29+/-0.17	<0.283 to 1.05+/-0.326	PZ-100-SD
Fhorium-230 (Total)	<0.736 to 0.84+/-0.29	<0.473 to 0.845+/-0.288	PZ-100-SD

Notes:

Background data from PZ-300-SS, PZ-301-SS, PZ-204A-SS Radionuclide results presented in pCi/l

Based on the data presented in Table 4.10, many of the metals and conventionals were undetected in the Deep Salem detection piezometers. These include antimony, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and cyanide (total). The range of concentration for all metal and conventional parameters in the Deep Salem groundwater samples is similar to the background range, with the possible exception of barium and manganese. Similar to the results for the St. Louis/Upper Salem groundwater samples, the range of barium and manganese concentrations for the detection samples is higher than the background range. However, the range for the St. Louis/Upper Salem and Deep Salem groundwater samples are similar to each other, suggesting that the results for both the St. Louis/Upper Salem and the Deep Salem hydrogeologic units represent natural variability.

The Deep Salem groundwater results do not suggest impacts from on-site activities. Split laboratory results are consistent with the prime laboratory results. Section 10 discusses data comparability in more detail.

#### 4.5.3 Alluvium

Eleven alluvial groundwater monitoring locations were incorporated into the OU-2 RI. These include:

PZ-303-AS	MW-107
PZ-304-AS	PZ-300-AS
PZ-304-AI	PZ-300-AD
PZ-113-AS	S-80
PZ-113-AD	I-50
MW-103	

Piezometers/Wells PZ-300-AS, PZ-300-AD, S-80, I-50, and MW-107 were included in the off-schedule sampling event conducted in December 1995. These locations provide background alluvial groundwater quality data. Piezometers/Wells PZ-300-AS, PZ-300-AD, S-80 and I-50 were decommissioned prior to the two scheduled RI sampling rounds.

Only five of the alluvial monitoring locations exhibited detectable concentrations of VOCs above the reporting limit. These include PZ-113-AS, PZ-113-AD, MW-103, PZ-303-AS, PZ-304-AS, and PZ-304-AI. As discussed in Section 4.7, piezometers PZ-303-AS, PZ-304-AS, and PZ-304-AI were installed near monitoring well MW-F2, in an area of suspected petroleum impacts. Monitoring well MW-103 is located along the western side of the inactive landfill. PZ-113-AS and PZ-113-AD are located between the inactive landfill, the demolition landfill, OU-1 Area 2, OU-1 Area 1, and the previously-filled active landfill permitted area (see Figure 4.2).

VOCs in PZ-113-AS and PZ-113-AD were limited to chlorobenzene in PZ-113-AS and 1,1-dichlorethane in PZ-113-AD. Chlorobenzene was detected in PZ-113-AS at a concentration of 0.0086 mg/l in the first sampling round and 0.003 mg/l in the second sampling round, compared to a reporting limit of 0.002 mg/l. VOC 1,1-dichloroethane was detected at the reporting limit of 0.002 mg/l in PZ-113-AD during the second sampling round, but was not detected in the first sampling round.

The only VOC detected in MW-103 was 1,2-cis-dichloroethene, at a concentration of 0.0044 mg/l in the second sampling round. No VOCs were detected in MVV-103 in the first sampling round.

VOC detections in PZ-303-AS, PZ-304-AS, PZ-304-AI, and MW-103 were more varied and more consistent. Table 4.11 summarizes the VOC concentrations in these sampling locations.

Only one alluvial piezometer yielded a detectable concentration of semi-volatile organic compounds. PZ-303-AS exhibited detectable concentrations of four semi-volatile organic compounds in the first sampling round and three semi-volatile organic compounds in the second sampling round.

No pesticides or PCBs were detected in the alluvial wells.

Table 4.11 Volatile organic compounds in PZ-303-AS, PZ-304-AS, and PZ-304-AI

	<del></del>					
		Round 1			Round 2	
Compounds	PZ-303-AS	PZ-304-AS	PZ-304-AI	PZ-303-AS_	PZ-304-AS	PZ-304-AI
Acetone	0.009	<0.005	<0.005	<0.005	<0.005	<0.005
Benzene	0.078	0.005	0.010	0.078	0.0062	0.011
Chlorobenzene	<0.002	0.008	<0.002	<0.002	0.0087	<0.002
Chloroethane	0.013	<0.002	<0.002	0.011	<0.002	<0.002
1,2-Dichloroethane	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichlorobenzene	<0.002	<0.002	<0.002	0.0038	<0.002	<0.002
1,4-Dichlorobenzene	<0.002	0.012	0.003	0.0034	0.012	0.0033
1,1-Dichloroethane	<0.002	0.002	<0.002	0.033	<0.002	<0.002
1,1-Dichloroethylene	<0.002	<0.002	<0.002	<0.002	0.003	<0.002
1,2-cis-Dichloroethylene	0.008	0.006	0.011	0.0081	0.0067	0.013
1.2-trans-Dichloroethylene	0.002	<0.002	<0.002	0.0025	<0.002	<0.002
Ethylbenzene	0.120	<0.002	<0.002	0.113	<0.002	<0.002
Methyl Ethyl Ketone	0.007	<0.002	<0.002	<0.005	<0.005	<0.005
Styrene	0.006	<0.002	<0.002	<0.002	<0.002	<0.002
Toluene	0.400	<0.002	<0.002	0.380	<0.002	<0.002
Vinyl Chloride	0.012	0.012	0.010	0.026	0.0076	0.0062
Total Xylenes	0.670	<0.002	<0.002	0.530	<0.002	<0.002

Notes:

Results shown in mg/l

Sample results above reporting limit are shown in boldface/italics type

Table 4.12 compares the range of metal concentrations, conventional concentrations and radionuclide activities in the alluvial piezometers to the background range. Based on the data presented in Table 4.12, many of the metals and conventionals were undetected in both the detection piezometers. These include dissolved antimony, beryllium, cadmium, dissolved chromium, cobalt, copper, lead, mercury, silver, thallium, vanadium, dissolved zinc, cyanide (total), and sulfide as S.

Five metals and conventional parameters (arsenic, barium, boron, iron, and ammonia as N) exhibit a maximum detection sample result that is about 10 times or more greater than the background maximum concentration. The maximum concentration for each of these parameters was exhibited by piezometers PZ-303-AS or PZ-304-AS, which are located along the western side of the inactive landfill. Otherwise, however, the range of detection results is similar to the range of background results, allowing for natural variability.

The organic and metal concentrations in the alluvial groundwater near OU-2 are similar to the organic and metal concentrations in OU-1 monitoring points, as described in the Groundwater Conditions Report, West Lake Landfill Areas 1 & 2, prepared by McLaren/Hart Environmental Engineering Corporation and dated November 26, 1996. Organic compounds were detected only sporadically, and metals were generally present at or near background concentrations.

No source of radioactivity in OU-2 has been identified or is suspected. Based on the radiological data collected as part of the OU-2 RI, groundwater quality appears to reflect natural radioactivity.

Table 4.12 Comparison of alluvial detection results to background alluvial groundwater quality

Parameter	Range of background concentrations (mg/l)	Range of detection results (mg/l)	Piezometer exhibiting the maximum detection concentration
Metals	(9.1)	(111977)	- Concentration
Antimony (Dissolved)	<0.003 to <0.003	<0.003 to <0.003	
Antimony (Total)	<0.003 to <0.003	<0.003 to 0.004	PZ-113-AD
Arsenic (Dissolved)	0.004 to 0.004	<0.002 to 0.094	PZ-304-AS
Arsenic (Total)	0.004 to 0.004	<0.002 to 0.087	PZ-303-AS
Barium (Dissolved)	0.152 to 0.178	0.089 to 1.24	PZ-304-AS
Barium (Total)	0.152 to 0.182	0.091 to 1.23	PZ-304-AS
Beryllium (Dissolved)	<0.001 to <0.001	<0.001 to <0.001	
Beryllium (Total)	<0.001 to <0.001	<0.001 to <0.001	
Boron (Dissolved)	<0.1 to <0.1	<0.1 to 0.831	PZ-304-AS
Boron (Total)	<0.1 to <0.1	<0.1 to 0.847	PZ-304-AS
Cadmium (Dissolved)	<0.005 to <0.005	<0.005 to <0.005	
Cadmium (Total)	<0.005 to <0.005	<0.005 to <0.005	
Calcium (Dissolved)	158 to 159	112 to 300	PZ-303-AS
Calcium (Total)	131 to 176	103 to 290	PZ-303-AS
Chromium (Dissolved)	<0.010 to <0.010	<0.010 to <0.010	
Chromium (Total)	<0.010 to 0.011	<0.010 to 0.017	PZ-303-AS
Cobalt (Dissolved)	<0.020 to <0.020	<0.020 to <0.020	
Cobalt (Total)	<0.020 to <0.020	<0.020 to <0.020	
Copper (Dissolved)	<0.020 to <0.020	<0.020 to <0.020	
Copper (Total)	<0.020 to <0.020	<0.020 to <0.020	
Iron (Dissolved)	3.33 to 4.06	<0.04 to 92	PZ-303-AS
Iron (Total)	1.98 to 2.83	0.063 to 90.1	PZ-303-AS
Lead (Dissolved)	<0.002 to <0.002	<0.002 to <0.002	
Lead (Total)	<0.002 to <0.002	<0.002 to <0.002	
Magnesium (Dissolved)	56.4 to 58.0	38.3 to 89.0	PZ-303-AS
Magnesium (Total)	41.6 to 57.8	39.8 to 84.3	PZ-303-AS
Manganese (Dissolved)	3.09 to 3.32	0.017 to 6.54	PZ-113-AS
Manganese (Total)	3.05 to 3.14	0.077 to 6.39	PZ-113-AS

Table 4.12 Comparison of alluvial detection results to background alluvial groundwater quality (continued)

Parameter	Range of background concentrations (mg/l)	Range of detection results (mg/l)	Piezometer exhibiting the maximum detection concentration
Metals (continued)	(1.3.7)	<u>\.\.\.</u>	
Mercury (Dissolved)	<0.0002 to <0.0002	<0.0002 to <0.0002	
Mercury (Total)	<0.0002 to <0.0002	<0.0002 to <0.0002	
Nickel (Dissolved)	<0.04 to <0.04	<0.04 to 0.04	PZ-304-AS
Nickel (Total)	<0.04 to <0.04	<0.04 to 0.044	PZ-304-AS
Selenium (Dissolved)	<0.002 to <0.002	<0.002 to 0.024	MW-103
Selenium (Total)	<0.002 to <0.002	<0.002 to 0.018	MW-103
Silver (Dissolved)	<0.010 to <0.010	<0.010 to <0.010	
Silver (Total)	<0.010 to <0.010	<0.010 to <0.010	
Sodium (Dissolved)	43.4 to 44.9	12.5 to 197	PZ-304-AS
Sodium (Total)	35.4 to 73.0	12.8 to 206	PZ-304-AS
Thallium (Dissolved)	<0.002 to <0.002	<0.002 to <0.002	
Thallium (Total)	<0.002 to <0.002	<0.002 to <0.002	
Vanadium (Dissolved)	<0.010 to <0.010	<0.010 to <0.010	
Vanadium (Total)	<0.010 to <0.010	<0.010 to <0.010	
Zinc (Dissolved)	<0.030 to <0.030	<0.030 to <0.030	
Zinc (Total)	<0.030 to <0.030	<0.030 to 0.056	PZ-113-AS
Conventionals			
Ammonia as N	0.4 to 0.4	<0.1 to 56.1	PZ-304-AS
Chemical Oxygen Demand	<15 to 40	<15 to 108	PZ-303-AS
Chloride	130 to 215	17 to 299	PZ-304-AS
Cyanide, Total	<0.010 to <0.010	<0.010 to <0.010	
Fluoride	0.27 to 0.36	<0.25 to 0.73	PZ-304-AS
Hardness, Total	660 to 700	470 to 1100	PZ-303-AS
Nitrate/Nitrite	<0.1 to <0.1	<0.1 to 0.3	MW-103
Phosphorus, Total	0.39 to 0.63	<0.01 to 1.5	PZ-303-AS
Sulfate as SO4	62 to 110	<2 to 67	MW-103
Sulfide as S	<1 to <1	<1 to 1	MW-103
Total Dissolved Solids	933 to 940	86 to 1396	PZ-303-AS
Total Organic Carbon	2 to 3	3 to 30	PZ-304-AS
Radionuclides			
Gross Alpha (Dissolved)	<3.03 to <8.19	<6.22 to 9.83+/-3.22	MW-103
Gross Alpha (Total)	<3.53 to 56.1+/-9.5	<7.27 to 9.61+/-6.23	PZ-304-AI
Gross Beta (Dissolved)	<3.94 to 6.02+/-3.00	9.2+/-2.12 to 49.2+/-8.33	PZ-304-AS
Gross Beta (Total)	4.38+/-2.49 to 53.1+/-6.2	<7.21 to 49.5+/-7.24	PZ-304-AS
Radium-226 (Dissolved)	0.069+/-0.029 to 0.35+/-0.05	<0.415 to 1.39+/-0.6	PZ-113-AD
Radium-226 (Total)	<0.066 to 0.51+/-0.07	<0.419 to 2.31+/-0.803	PZ-113-AD
Uranium-234 (Dissolved)	0.25+/-0.13 to 0.88+/-0.26	<0.275 to 3.71+/-0.969	MW-103
Uranium-234 (Total)	0.32+/-0.15 to 0.99+/-0.31	<0.261 to 4.18+/-1	MW-103
Uranium-235/236 (Dissolved)	<0.10 to 0.16+/-0.11	<0.139 to <0.595	PZ-303-AS
Uranium-235/236 (Total)	<0.09 to 0.27+/-0.17	<0.136 to <0.623	PZ-304-AI
Uranium-238 (Dissolved)	<0.097 to 0.63+/-0.21	<0.139 to 4.17+/-0.969	MW-103
Uranium-238 (Total)	<0.258 to 1.19+/-0.35	<0.155 to 3.67+/-0.906	MW-103
Thorium-230 (Dissolved)	<0.627 to 0.93+/-0.30	<0.523 to 0.964+/-0.435	PZ-304-AI
Thorium-230 (Total)	<0.415 to 1.48+/-0.40	<0.447 to 1.21+/-0.374	PZ-304-AS

Note: Radionuclide results presented in pCi/l

Split laboratory results are consistent with prime laboratory results. Section 10 discusses data comparability in more detail.

## 4.6 Comparison of clustered piezometer groundwater quality results

Several piezometer clusters were installed as part of the OU-2 RI. These clusters provided data regarding vertical hydraulic gradients that influence groundwater flow directions, as discussed in the *Physical Characterization Memorandum*. In addition, the *Work Plan* indicated that the sampling results from the clustered locations be used to discuss vertical profiles of groundwater quality.

Piezometer clusters that have concurrent groundwater quality data include:

PZ-113-AS/PZ-113-AD/PZ-113-SS

PZ-100-SS/PZ-100-SD

PZ-104-SS/PZ-104-SD

PZ-106-SS/PZ-106-SD

PZ-116-SS/MW-1204

PZ-304-AS/PZ-304-AI

Based on the general lack of detectable organic compounds throughout the site, it is not possible to utilize organic results to confidently determine vertical changes in groundwater quality. The exception is piezometer cluster PZ-304-AS/PZ-304-AI. Table 4.13 compares the detected organic compounds in PZ-304-AS to the detected organic compounds in PZ-304-AI. The few organic compounds that were detected were present at low concentrations, near the reporting limit. The cluster data support a conclusion that groundwater quality is at or near background concentrations throughout most of the site, with the possible exception of alluvial groundwater in a limited area near MW-F2 in the southwestern corner of the site.

Table 4.13 Organic compounds in cluster piezometers PZ-304-AS and PZ-304-AI

	Rou	ind 1	Rou	ınd 2
Compounds	PZ-304-AS	PZ-304-AI	PZ-304-AS	PZ-304-AI
Benzene	0.005	0.010	0.0062	0.011
Chlorobenzene	0.008	<0.002	0.0087	<0.002
1,4-Dichlorobenzene	0.012	0.003	0.012	0.0033
1,1-Dichloroethane	0.002	<0.002	<0.002	<0.002
1,1-Dichloroethylene	<0.002	< 0.002	0.003	<0.002
1,2-cis-Dichloroethylene	0.006	0.011	0.0067	0.013
Vinyl Chloride	0.012	0.010	0.0076	0.0062

Notes:

Results shown in mg/l

Sample results above reporting limit are shown in boldface/italic type

No semi-volatile organic, pesticide, or PCBs were detected

All detected organic compounds are landfill gas constituents. See Section 8.

Comparison of metal, conventional, and radionuclide results between clusters is also not useful for generating vertical groundwater quality profiles at the West Lake OU-2 site because almost all of the parameters were either undetected or were present at or near background concentrations.

## 4.7 Petroleum impacts near MW-F2

A goal of OU-2 RI was to investigate potential petroleum impacts near monitoring well MW-F2 and west/southwest of the asphalt plant leaking underground storage tank site (LUST site) within the boundaries of OU-2. Petroleum odors have historically been noted emanating from the PVC casing in MW-F2. To provide reliable groundwater quality data, piezometer PZ-303-AS was installed within about 75 ft of MW-F2 as part of the OU-2 RI. Piezometers PZ-304-AS and PZ-304-AI were installed about 450 ft from MW-F2.

Purgeable-range (ie, light-range) petroleum hydrocarbons and extractable-range (ie, heavy-range) petroleum hydrocarbons were analyzed in groundwater samples. The results for PZ-303-AS, PZ-304-AS, and PZ-304-AI are summarized as follows:

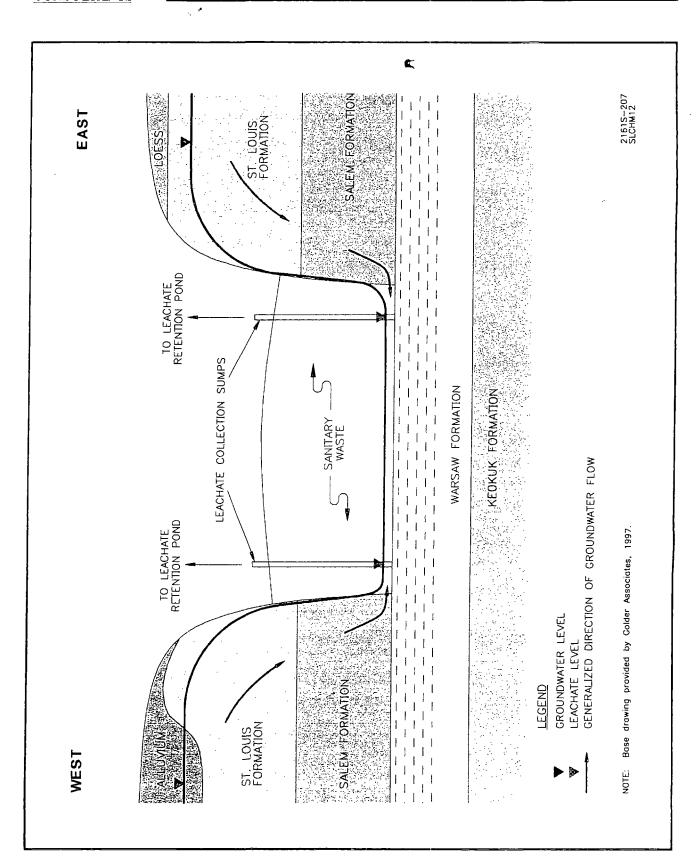
Sample location		je hydrocarbons g/l)	•	ge hydrocarbons g/l)
	Feb 97	May 97	Feb 97	May 97
PZ-303-AS	1.3	3.12	19	10
PZ-304-AS	<0.05	0.08	0.99	0.6
PZ-304-Al	< 0.05	0.53	0.61	0.4

As shown, there are detectable petroleum hydrocarbons in the alluvial groundwater samples collected from these locations. The highest concentrations were present in samples collected from PZ-303-AS, installed closest to MW-F2. The maximum concentration of total petroleum hydrocarbons is 20.3 mg/l (the total hydrocarbons in PZ-303-AS in February 1997), which is well below typical stringent LUST cleanup criteria of 50 mg/l (Missouri Department of Natural Resources, 1996). Baseline risk assessment procedures will be used to determine the risks associated with the low concentrations of petroleum hydrocarbons in the alluvium in the western portion of the site.

# 4.8 Summary of groundwater quality

The results of the hydrogeologic investigation and groundwater monitoring program can be used to determine potential contaminant migration pathways and the potential for leachate from the inactive landfill areas to have impacted groundwater quality in the site vicinity. Based on the data collected, the inward hydraulic gradient toward the active sanitary landfill that was inferred based on water level elevations has been confirmed using groundwater quality data. Landfill gas impacts have been confirmed in one monitoring location (PZ-1201-SS) immediately adjacent to the active sanitary landfill (see Section 8). Elsewhere on the site, only sporadic, low-level detections of selected parameters have been observed. These are concluded to be the result of historic solid waste disposal throughout most of the site. One area, in alluvium along the western portion of the site near monitoring well MW-F2 and west/southwest of the asphalt plant LUST site within the boundaries of OU-2, exhibits potential impacts. The next section will discuss surface water and sediment quality, to determine if the alluvial impacts along the western portion of the site have resulted in impacts to the Earth City Stormwater Retention Pond downgradient of the site.

Figure 4.1 Conceptual hydrogeologic model



# 5 SURFACE WATER AND SEDIMENT QUALITY

# 5.1 Overview

As described in the *Work Plan*, two surface water and sediment sampling locations were included in the OU-2 RI. The first location was upstream of the site, at a background location south of the site. The second location was within the Earth City Stormwater Retention Pond, at a location that would be expected to receive runoff impacts from the inactive landfill, if impacts occurred. Consistent with the *Physical Characterization Memorandum*, the upstream surface water location was designated SW-01, and the upstream sediment location was designated SED-01. The downstream surface water and sediment sampling locations were designated SW-02 and SED-02, respectively. The downstream surface water and sediment sampling locations were selected to provide data near and potentially downgradient of the monitoring well MW-F2, area which had exhibited potential petroleum impacts through landfill gas monitoring and soil TOC results.

Sediment samples were collected adjacent to the corresponding surface water sample locations, consistent with the specifications included in the *Physical Characterization Memorandum*, to allow direct comparison of surface water and sediment quality at the designated locations. Figure 4.2 illustrates the surface water and sediment sampling locations.

# 5.2 Analytical results

# 5.2.1 Surface water

Appendix C presents surface water quality results for the primary and split laboratories. Surface water samples were analyzed for the same compounds as groundwater. As shown in Appendix C all volatile organic, semi-volatile organic, pesticide, and PCB results were below detection in both the upstream sample and in the sample collected west of the inactive landfill. With regard to inorganic parameters, the upstream and downstream surface waters exhibit similar concentrations. The radiological results are also consistent between the upstream and downstream. The upstream sample exhibited low levels of uranium-234 and uranium-238 while the downstream sample did not yield detectable levels of these isotopes. These results illustrate the natural variability of radioactivity in the area, and substantiate the fact that the OU-2 area is not contributing radionuclides to surface water.

In summary, based on the surface water results, the OU-2 area is not contributing measurable contamination to the Earth City Stormwater Retention Pond.

#### 5.2.2 Sediment

Sediment samples were analyzed for the same list of compounds as groundwater and surface water, except that all metals were analyzed as total, conventionals included only total cyanide and sulfide, and radionuclides were not analyzed. Consistent with the EPA-approved Work Plan, the sediment analyte list included VOCs, semi-volatile organics, pesticides, PCBs, petroleum hydrocarbons, total cyanide, sulfide, and metals.

Based on data presented in Appendix C, the upstream sediment quality is consistent with the downstream sediment quality, with similar parameters detected at similar concentrations. With the exception of acetone and methyl ethyl ketone in the upstream sediment sample, all volatile organic, semi-volatile organic, pesticide, and PCB results were below detection. Inorganic concentrations in the upstream and downstream sediment samples were similar.

Based on the sediment results, the OU-2 area is not contributing measurable contamination to the Earth City Stormwater Retention Pond.

# LEACHATE SAMPLING AND ANALYSIS

6

Leachate sampling and analysis were conducted to determine whether past disposal practices might have resulted in source areas for contamination in the inactive landfill. Specifically, the EPA, in the Aerial Photographic Analysis of the West Lake Landfill Site, Bridgeton, Missouri (EPA, 1989 and 1991), identified standing water pools that were inferred to represent potential liquid disposal areas within the inactive landfill. The leachate sampling points were installed in areas identified by the EPA as potential liquid disposal areas. The data obtained from the leachate risers were intended to be used to identify potential hazardous substances, if present, within these areas of the inactive landfill. In addition to sampling leachate from the inactive landfill, samples of leachate were collected from leachate risers previously installed within the active sanitary landfill. The leachate riser data from the active sanitary landfill can be compared to the leachate quality in the inactive landfill.

Six leachate riser borings were made within the inactive landfill as part of the OU-2 RI. Of these six, one was dry and did not receive a leachate riser, while a second received a leachate riser but consistently exhibited a liquid thickness of less than six inches, which was insufficient for sample collection. The remaining four inactive landfill leachate risers were sampled to determine leachate quality. Four leachate risers present in the active sanitary landfill were also sampled.

The Work Plan indicated that leachate samples would be analyzed for the same list of compounds as groundwater and surface water samples. Leachate samples were analyzed for VOCs, semi-volatile organics, pesticides, PCBs, petroleum hydrocarbons, total cyanide, sulfide, metals, and radionuclides. Although selected conventional parameters included in groundwater and surface water samples were inadvertently deleted from the leachate analyte list, the VOC, semi-volatile organic, pesticide, PCB, petroleum hydrocarbon, total cyanide, sulfide, metals, and radionuclide data are sufficient to characterize leachate quality and meet the objectives of the RI.

Table 6.1 compares organic compounds above laboratory reporting limit for the leachate risers in the active sanitary landfill (labeled with a prefix "LCS") to organic compounds above laboratory reporting limit for the leachate risers in the inactive landfill (labeled with a prefix "LR"). Organic compound detection frequency was low in each group of leachate risers. Only one organic compound (total petroleum hydrocarbons) was detected in two of the four inactive landfill leachate samples (LR-103 and LR-104). All other organic compounds were below detection in these two samples. Organic compound concentrations for detected compounds in the inactive landfill leachate are consistently within the range of the concentrations for the active sanitary landfill leachate. Solvents, such as tetrachlorethene, trichloroethene, vinyl chloride, etc., were not detected in the inactive landfill leachate samples.

Radionuclide concentrations in the inactive landfill leachate samples were similar to the radionuclide concentrations in the active sanitary landfill leachate (see Appendix C). The active sanitary landfill is not permitted to accept radioactive waste. Based on the similar radionuclide concentrations, a significant source of radioactivity is not present in the inactive landfill.

In summary, fewer organic compounds were present in the inactive landfill leachate and were detected at lower concentrations than in the active sanitary landfill leachate. In addition, no solvents were present in the inactive landfill leachate. These results indicate that standing water pools identified by EPA in its aerial reconnaissance review were most likely not liquid disposal locations. Rather, the standing water pools were most like the result of small depressions that collected precipitation.

Table 6.1 Organic compounds detected in leachate

	A	ctive Sanitary	Landfill Leacha	ite		Inactive Lan	dfill Leachate	
Compound	LCS-1	LCS-2	LCS-3	LCS-4	LR-100	LR-103	LR-104	LR-105
Acetone	1.2	0.65	0.038	0.61	<0.010	<0.010	<0.010	0.04
Benzene	<0.5	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	0.007
Chlorobenzene	<0.5	0.035	0.029	0.011	0.044	<0.005	< 0.005	0.74
1,4-Dichlorobenzene	<0.5	0.081	0.009	0.056	0.01	< 0.005	<0.005	0.068
Ethylbenzene	<0.5	0.049	0.023	0.07	0.012	<0.005	<0.005	0.089
2-Hexanone	<1	0.1	<0.010	0.18	<0.010	<0.010	<0.010	<0.010
Methyl Ethyl Ketone	3	1.3	0.11	2.6	<0.010	<0.010	<0.010	<0.010
Methyl iso-butyl Ketone	<1	0.08	<0.010	0.076	<0.010	<0.010	<0.010	<0.010
Styrene	<0.5	0.005	<0.005	0.006	< 0.005	< 0.005	<0.005	<0.005
Toluene	<0.5	0.097	0.015	0.12	< 0.005	<0.005	<0.005	0.007
Total Xylenes	<0.5	0.14	0.035	0.17	0.057	<0.005	< 0.005	0.43
m+p Cresol	1.9	0.95	0.077	0.26	<0.010	<0.010	<0.010	R
2,4-Dimethylphenol	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.082
bis(2-ethylhexyl)phthalate	0.019	0.022	0.017	<0.010	0.12	<0.006	<0.006	0.036
Diethyl phthalate	0.033	<0.010	<0.010	<0.010	< 0.010	<0.010	<0.010	<0.010
Dimethyl phthalate	0.012	<0.010	<0.010	<0.010	< 0.010	< 0.010	<0.010	<0.010
Phenol	0.29	0.16	<0.010	0.017	<0.010	<0.010	<0.010	R
Naphthalene	<0.010	< 0.010	<0.010	<0.010	0.011	< 0.010	<0.010	<0.010
Volatile Petroleum Hydrocarbons	0.41	0.4	0.12	0.48	0.17	< 0.05	< 0.05	0.95
Diesel-range Petroleum Hydrocarbons	79	6.9	2.2	0.22	2.2	0.63	0.08	4.4

Notes:

All results in mg/l

R: Data point rejected during data validation

Results above the reporting limit are shown in boldface/italic type

Inactive landfill leachate riser LR-101 was not installed due to the absence of leachate at this location.

Inactive landfill leachate riser LR-102 was not sampled due to minimal (<6 inches) liquid thickness.

# 7 SEEP SURVEY RESULTS

The entire OU-2 area was repeatedly observed for the presence of landfill seeps. No seeps capable of exiting the site were found. One seep was initially observed in the northeastern portion of the inactive landfill, near the asphalt plant. Any flow from this seep would remain in the area immediately surrounding the seep, and would have no possibility of off-site impact. The seep was observed to flow only minimally. A sample was collected and was submitted for analysis. The laboratory experienced severe analytical problems to the extent that additional samples were required. Despite repeated walk-overs of the seep area, no additional seepage was observed. This suggests that the seep was a temporary feature and was not a significant component of the overall RI/FS.

## 8 LANDFILL GAS CHARACTERIZATION

Landfill gas characterization was accomplished using various measurement techniques. Health and safety air monitoring was conducted during the drilling of each of the 49 borings completed as part of the OU-2 RI to determine potential landfill gas impacts in the breathing zone. Health and safety air monitoring equipment included a photoionization detector and a combustible gas indicator, which were used to verify that methane, hydrogen sulfide, and organic compound concentrations remained at or near background levels. Health and safety air monitoring results were consistently within acceptable background ranges throughout the OU-2 RI, indicating that appreciable landfill gas impacts are not occurring. Hydrogen cyanide was to be quantified during the OU-2 RI only if gas was observed actively venting from the borehole. Active venting was not observed, and hydrogen cyanide measurements were made infrequently at the beginning of the OU-2 RI field program to confirm the lack of impacts. Hydrogen cyanide was not detected.

Additional landfill gas monitoring was conducted along the western portion of the inactive landfill. An ATV mounted Geoprobe drill rig advanced expendable sampling points to a depth of approximately 3.5 ft below ground surface at 10 locations shown in Figure 8.1. The holes were observed for natural venting. If natural venting of landfill gas was observed, the holes were allowed to vent for approximately 20 minutes before sampling. If natural venting was not observed, a peristaltic pump was attached and the hole was purged for 20 minutes to draw landfill gas into the hole. Polyethylene tubing was connected to the sampling point and a new Tedlar bag at each sampling point. The Tedlar bag was placed inside of a vacuum box, and a vacuum was applied, causing landfill gas to be drawn into the Tedlar bag. The Tedlar bag assured consistent volumes of landfill gas at each sampling point. After the sample container was filled, a photoionization detector and combustible gas indicator were used to determine volatile organic compound, hydrogen sulfide, and combustible gas emissions in the sample bag. Results of the soil gas are presented in Table 8.1. Hydrogen sulfide was not detected at any of the 10 locations. The percent lower explosive limit was zero in eight of the 10 locations. SG-03 exhibited a landfill gas concentration at 3% of the lower explosive limit at a depth of 3.5 ft below ground surface. Location SG-08, near monitoring well MW-F2, exhibited a landfill gas concentration of 130% of the lower explosive limit at a depth of 3.5 ft below ground surface. Locations SG-03 and SG-05 were the only two to exhibit detectable concentrations of organic vapors. Sample SG-03 exhibited an organic vapor concentration of 7.6 ppm. Sample SG-05 exhibited an organic vapor concentration of 10.1 ppm. These landfill gas results indicate sporadic, isolated landfill gas impacts near the inactive landfill, and are typical for a solid waste landfill.

Location	PID	Percent oxygen	Percent lower explosive limit	Hydrogen sulfide
	(ppm)			(ppm)
SG-01	0.0	20.8	0	0.0
SG-02	0.0	18.9	0	0.0
SG-03	7.6	14.4	2	0.0
SG-04	0.0	18.7	0	0.0
SG-05	10.1	18.3	0	0.0
SG-06	0.0	20.6	0	0.0
SG-07	0.0	20.7	0	0.0
SG-08	0.0	18.8	130	0.0
SG-09	0.0	14.0	0	0.0
SG-10	0.0	18.9	0	0.0

Table 8.1 West Lake Landfill soil gas screening results

Direct measurements of landfill gas were made by collecting gas in SUMMA canisters from 10 boreholes drilled within the inactive landfill. The boreholes were installed along the crest of the inactive landfill (Figure 8.1), in areas where landfill gas would likely accumulate and as companion measurement points for selected leachate risers discussed in Section 6. An ATV mounted Geoprobe drill rig advanced expendable sampling points to a depth of approximately 3.5 ft below ground surface. The holes were observed for natural venting. If natural venting of landfill gas was observed, the holes were allowed to vent for approximately 20 minutes before sampling. If natural venting was not observed, a peristaltic pump was attached was the hole was purged for 20 minutes to draw landfill gas into the hole. Polyethylene tubing attached to the expendable sampling point was connected at ground surface to a SUMMA canister. SUMMA canisters were used to directly collect samples of landfill gas for subsequent laboratory analysis of organic compounds using EPA Method TO-14 by Air Toxics Ltd. of Folsom, California. compounds included Freon compounds, which are commonly associated with refrigerants that were probably disposed as "white goods" (ie, refrigerators, etc.) within the inactive landfill. White goods were historically not separated from other solid waste material and would be expected in an older solid waste landfill such as the inactive landfill.

Table 8.2 compares landfill gas constituents presented in *Integrated Solid Waste Management Engineering Principles and Management Issues* (Tchobanoglous, et al, 1993) to the inactive landfill gas constituents. For compounds present in both the inactive landfill gas and typical landfill gas, the concentrations of inactive landfill compounds are less than the mean result for typical landfill gas compounds, with the exception of acetone. The acetone concentration for the inactive landfill gas, although slightly greater than the mean concentration in typical landfill gas, is still an order of magnitude less than the maximum concentration for typical landfill gas.

Selected compounds were present in the inactive landfill gas that were not reported in typical landfill gas and may not have been tested as part of the Tchobanoglous, et al study (Table 8.2). These were present at low concentrations and do not suggest a definable source of hazardous substances that is emitting significant vapors into the inactive landfill gas.

Table 8.2 West Lake inactive landfill gas concentrations versus typical municipal solid waste landfill gas constituents

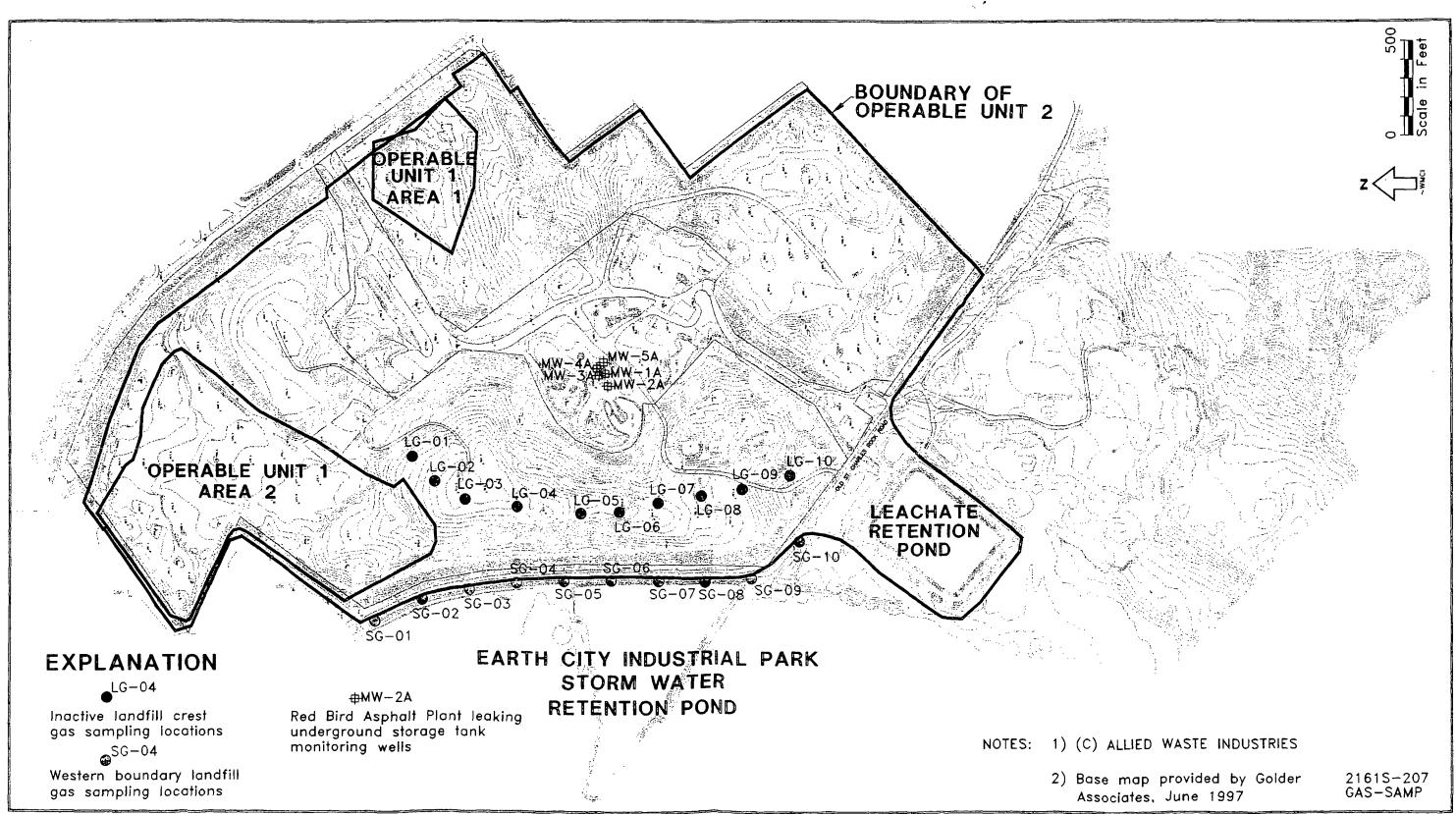
Typical landfill g	as constituen	ts*	Inactive la	ndfill gas	
Detected compound	Mean	Maximum	Detected compound	Result	Location
	result	result			
	(ppmV)	(ppmV)		(ppmV)	
Acetone	6.838	240.000	Acetone	24.000	LG-05
Benzene	2.057	39.000	Benzene	0.4100	LG-08
Chlorobenzene	0.082	1.640	Chlorobenzene	1.1000	LG-05
Chloroform	0.245	12.000			
1,1 Dicholoroethane	2.801	36.000			
Dichloromethane	25.694	620.000			
1,1 Dicholoroethene	0.130	4.000			
Diethylene chloride	2.835	20.000			
1,2-trans-Dichloroethane	0.036	0.850			
Ethyl benzene	7.334	87.500	Ethyl benzene	0.2400	LG-10
Methyl Ethyl Ketone	3.092	130.000	Methyl Ethyl Ketone	0.1800	LG-08
1,1,1 Trichloroethane	0.615	14.500			
Trichloroethylene	2.079	32.000			
Toluene	34.907	280.000	Toluene	1.2000	LG-01
1,2,2 Tetrachloroethane	0.246	16.000			
Tetrachloroethylene	5.244	180.000			
Vinyl chloride	3.508	32.000	Vinyl chloride	0.7400	LG-08
Styrenes	1.517	87.000			
Vinyl acetate	5.663	240.000			
Xylenes	2.651	38.000	Xylenes	0.9100	LG-10
			Chloroethane	0.2500	LG-01
			4 Ethyl Toluene	0.0460	LG-10
			Freon 11	0.0200	LG-10
			Freon 12	0.7800	LG-09
			Freon 114	0.5200	LG-08
			Methylene chloride	0.0610	LG-07
			1,4 Dichlorobenzene	0.0660	LG-05
			1,2,4 Trimethylbenzene	0.2600	LG-05
			1,3,5 Trimethylbenzene	0.0680	LG-05
			1,2-cis-Dichloroethylene	0.0071	LG-04
			Carbon disulfide	0.1300	LG-01

<sup>\*</sup> Source: Tchobanoglous, et al, 1993.

An additional landfill gas sample was collected from the headspace in monitoring well PZ-1201-SS. The headspace sample was collected to determine if landfill gas is impacting groundwater quality adjacent to the landfill areas. The headspace sample was collected by imitating a groundwater sampling event, which involved purging the well to dryness using a purge/sampling pump. The piezometer was capped with a specially-designed cap fitted with an in-line vapor sampling port to allow direct collection of gas. After allowing time for the water level in the piezometer to recover, a SUMMA canister was attached to the sampling port. A stopcock was opened, and the SUMMA canister collected a representative sample of vapors from within the piezometer. The SUMMA canister was shipped to Air Toxics Ltd. for analysis of organic vapors using EPA Method TO-14. The headspace sample yielded detectable concentrations of chloromethane, methylene chloride, benzene, ethyl benzene, xylene, acetone, carbon disulfide, and methyl ethyl ketone (2-butanone). As discussed in Section 4.5.1 groundwater in piezometer PZ-1201-SS exhibited detectable concentrations of acetone and benzene. These results confirm that landfill gas at the site has the potential to impact groundwater and can be considered the source of low-levels of organic compounds in groundwater.

In summary, extensive health and safety air monitoring data indicate that landfill gases are not significantly impacting air quality. Landfill gas is present within the inactive landfill, as with all landfills, but is present at concentrations typical of a solid waste facility. Landfill gas data do not support the presence of widespread or concentrated liquid disposal within the inactive landfill area. Based on gas monitoring conducted immediately west of the inactive landfill and in the headspace of piezometer PZ-1201-SS, landfill gas is migrating into the surrounding geologic media, and has the potential to impact groundwater quality adjacent to the active sanitary landfill and inactive landfills. A landfill gas monitoring system has recently been installed near the active sanitary landfill and will provide supplemental landfill gas data to determine compliance with solid waste landfill regulations.





# 9 ALLUVIAL SOIL ORGANIC ANALYSES

Alluvial soil samples from the screened interval in the "300" series piezometers and leachate risers LR-103 and LR-104 were analyzed for total organic carbon (TOC). Soil samples from PZ-303-AS were analyzed for total petroleum hydrocarbons (TPH) and VOCs, due to the piezometer's proximity to monitoring well MW-F2. Soil samples collected during drilling of four soil borings near monitoring well MW-F2 (Figure 9.1) were analyzed for TPH and VOCs. The TPH and VOC results can be used to determine potential impacts from landfill gas and groundwater migration. The results of the TOC analyses can be used for contaminant fate and transport modeling, as appropriate, during the baseline risk assessment.

Table 9.1 lists the TOC results from the piezometers, leachate risers, and soil gas boreholes drilled outside the inactive landfill footprint. Alluvium was not encountered in PZ-300-SS; therefore, TOC analyses were not performed on this piezometer. Leachate risers LR-103 and LR-104 encountered alluvial soils during drilling, and were therefore included in the TOC analyses. Soil gas borehole alluvial samples were collected at a depth of approximately 3.5 ft below ground surface.

Table 9.1 Total organic carbon results - piezometer, leachate riser, and solid gas probe soil samples

Sample location	Total organic carbon
	(mg/kg)
PZ-300-AS (16.0 -16.5 ft)	4,600
PZ-300-AD (40.5 - 41.0 ft)	420
PZ-302-AS (17.5 - 18.0 ft)	240
PZ-302-AI (35.5 - 36.0 ft)	360
PZ-304-AS (23.5 - 24 ft)	420
PZ-304-AI (35.5 - 36.0 ft)	360
PZ-305-AI (50 - 52 ft)	360
LR-103 (32.5 - 33 ft)	20,000
LR-104 (30.5 - 31 ft)	480
SG-01 (3.5 ft)	8,500
SG-02 (3.5 ft)	3,900
SG-03 (3.5 ft)	3,100
SG-04 (3.5 ft)	4,500
SG-05 (3.5 ft)	4,200
SG-06 (3.5 ft)	6,900
SG-07 (3.5 ft)	2,300
SG-08 (3.5 ft)	2,600
SG-09 (3.5 ft)	10,000
SG-10 (3.5 ft)	5,900

Based on the soil gas borehole TOC results presented in Table 9.1, TOC values near the ground surface west of the inactive landfill range from about 2,300 mg/kg (0.23%) to 10,000 mg/kg (1%). These results may be biased high because of potential landfill gas migration through the near-surface soils adjacent to the inactive landfill, which would have allowed transfer of organic compounds from the gas phase to the soils. Based on the piezometer and leachate soil TOC results, background TOC in the alluvium at depth is approximately 240 to 480 mg/kg (0.024% to 0.048%).

Two TOC values from the piezometer and leachate riser borehole soil samples were elevated. The TOC value obtained in PZ-300-AS at a depth of 16 to 16.5 ft below ground surface was 4,600 mg/kg (0.46%). Piezometer PZ-300-AS was a background piezometer installed approximately 2,000 south of the West Lake Landfill, in an apparently naturally wooded area. It is possible that the alluvial soils in this area are naturally higher in TOC than in other areas investigated as part of the OU-2 RI. Leachate riser LR-103 yielded a TOC value of 20,000 mg/kg (2%) from a depth of 32.5 to 33 ft below ground surface. Leachate riser LR-103 was drilled through solid waste fill associated with the inactive landfill before encountering alluvium at depth. Accordingly, the relatively high TOC value in LR-103 is most likely associated with landfill impacts.

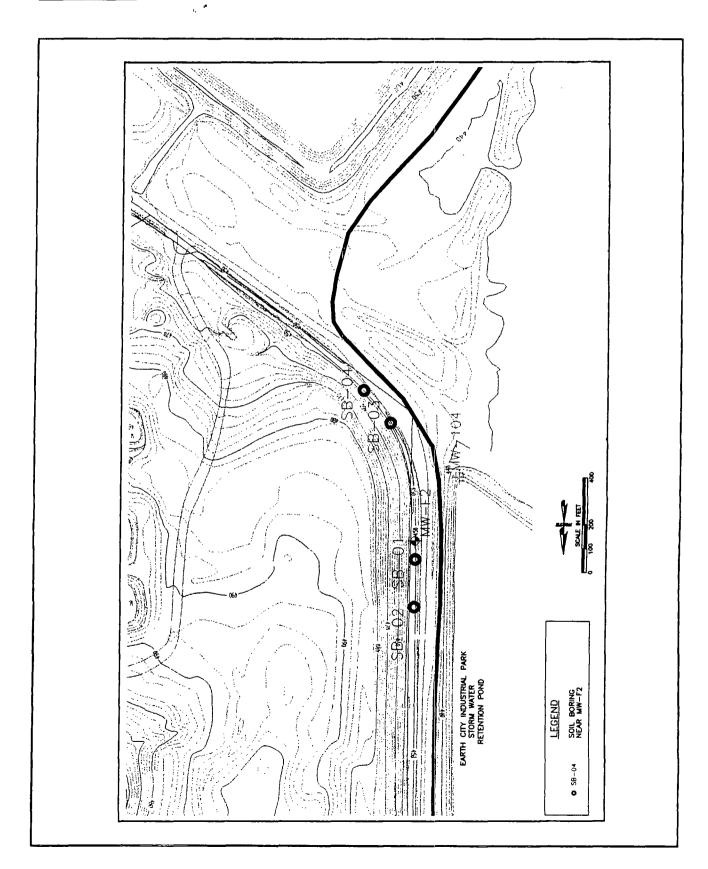
Because elevated organic concentrations were suspected in piezometer PZ-303-AS, and because PZ-303-AS was drilled the closest of any piezometer to the MW-F2 area west of the asphalt plant LUST site, TPH and VOC analyses were substituted for TOC analysis. Table 9.2 lists the TPH and VOC results for the two alluvial soil samples collected from PZ-303-AS, as well as soil borings drilled specifically to identify the extent of potential petroleum impacts near MW-F2. Detectable VOCs were limited to toluene, ethylbenzene, and total xylenes (common petroleum constituents) in the PZ-303-AS samples and SB-01, drilled adjacent to MW-F2. TPH results were presented as purgeable (ie, lighter fraction) and extractable (ie, heavier fraction). In the PZ-303-AS sample collected from a depth of 17 ft below ground surface and the SB-01 sample, the extractable fraction was present at a higher concentration than was the purgeable fraction. This suggests that petroleum impacts near the ground surface adjacent to the MW-F2 area are associated with the diesel range of compounds. Extractable-range petroleum hydrocarbons were detected in three of the four soil boring samples. Purgeable-range petroleum hydrocarbons and VOCs above the laboratory reporting limit were present only in SB-01, nearest to the MW-F2 area.

The TPH and VOC results support the potential for petroleum impact in a limited area near MW-F2, west/southwest of the asphalt plant LUST site.

Table 9.2 Alluvial soil total petroleum hydrocarbon and VOC results - piezometer PZ-300-AS; soil borings SB-01 through SB-04

	T	PH	
Sampling	Purgeable-range	Extractable-range	VOCs (mg/kg)
location	(mg/kg)	(mg/kg)	
PZ-303-AS (17 ft)	2,000	12,000	Toluene (5.3)
			Ethylbenzene (10)
			Total Xylenes (54)
PZ-303-AS (25 - 25.5 ft)	160	160	Total Xylenes (0.82)
SB-01 (16 - 18 ft)	6,700	15,000	Toluene (310)
,	,	•	Ethylbenzene (24)
			Total Xylenes (120)
SB-02 (4 - 6 ft)	<0.1	32	ND
SB-02 (14 - 16 ft)	<0.1	24	ND
SB-03 (6 - 8 ft)	<0.1	23	ND
SB-03 (10-12 ft)	<0.1	<10	ND
SB-04 (8 - 10 ft)	<0.1	<10	ND

ND: None detected



# 10 QUALITY ASSURANCE SAMPLES AND DATA VALIDATION

Data validation of environmental samples collected as part of the West Lake Landfill OU-2 RI was performed by Water Management Consultants, Inc. and Golder Associates, Inc. The purpose of the data validation was to assess the precision, accuracy, representativeness, completeness, comparability, and sensitivity of the analytical data reported and compare these attributes to the project goals set in the Work Plan, Appendix A-2, Final Quality Assurance Project Plan (QAAP) (Golder Associates, 1995).

Quality assurance (QA) goals were evaluated by reviewing the results of both field and laboratory QA samples. Field QA samples collected included field duplicates, field blanks, equipment rinseate blanks, and trip blanks. Field QA samples were collected at the frequency specified in the Work Plan. In addition to the collection of field QA samples, selected samples were split and sent to both primary and split laboratories. Some split sample locations proposed in the Physical Characterization Memorandum were modified in an attempt to select samples with detectable concentrations of target analytes. Agreement of the results between the two laboratories provides one method to assess the comparability of the data sets.

Laboratory QA samples analyzed included calibration standards, method blanks, laboratory control samples, matrix spike/matrix spike duplicate samples, and laboratory duplicate samples.

# 10.1 Analytical methods

Table 10.1 summarizes the groundwater, surface water, leachate, sediment, soil, and air samples that were collected for the West Lake Landfill OU-2 RI. Off-schedule groundwater samples collected in December 1995 were analyzed by Quanterra Laboratory of North Canton, Ohio. These samples were previously validated by Golder Associates and found to be 100% complete. Soil samples collected during drilling of piezometers, monitoring wells, and leachate sumps in 1995 and a sample of the water used for drilling were also analyzed by Quanterra and validated by Water Management Consultants.

Groundwater, surface water, leachate, sediment, soil, and air samples were collected during the first sampling round in February and March. The second round of sampling, conducted in May and June, included only groundwater samples. One air sample was collected in October. Selected groundwater, surface water, leachate, and sediment samples were split and sent to both a primary and split laboratory for analysis. The primary non-radiological laboratory was Pace Analytical Services, Inc., Houston, Texas. Analyses for Method 8310 PAHs were conducted at Pace's Petaluma, California laboratory. The primary radiological laboratory was Southwest Laboratory of Oklahoma, Broken Arrow, Oklahoma. The split non-radiological laboratory was TriMatrix Laboratories, Inc., Grand Rapids, Michigan and the split radiological laboratory was Paragon Analytics, Inc., Fort Collins, Colorado. Soil samples were analyzed at Pace, Houston and air samples were analyzed by Air Toxics, LTD., Folsom, California.

# Table 10.1 Summary of environmental samples collected during the West Lake Landfill Operable Unit 2 RI/FS

Date	Medium	Laboratory	Number of primary Environmental Samples	Number and Type of Quality Assurance Samples
1995	Groundwater	Quanterra Laboratory	4	None
	Soil	Quanterra Laboratory	17	4 Matrix Spikes 4 Matrix Spike Duplicates
	Drilling Water	Quanterra Laboratory	1	1 Trip Blank 1 Matrix Spike 1 Matrix Spike Duplicate
1997	Groundwater	Pace Analytical Services	48 (two rounds from 24 wells)	6 Field Duplicates 6 Field Blanks 6 Equipment Blanks 7 Matrix Spikes 7 Matrix Spike Duplicatès
		TriMatrix Laboratories	6 (two rounds from 3 wells)	<ul><li>2 Field Duplicates</li><li>2 Matrix Spikes</li><li>2 Matrix Spike Duplicates</li></ul>
		Southwest Laboratory of Oklahoma	48 (two rounds from 24 wells)	6 Field Duplicates 6 Field Blanks 6 Equipment Blanks
		Paragon Analytics	6 (two rounds from 3 wells)	2 Field Duplicates
	Leachate	Pace Analytical Services	8	1 Field Duplicate 1 Filed Blank 1 Matrix Spike 1 Matrix Spike Duplicate
		TriMatrix Laboratories	2	1 Matrix Spike 1 Matrix Spike Duplicate
		Southwest Laboratory of Oklahoma	8	1 Field Duplicate 1 Field Blank
		Paragon Analytics	2	
	Surface Water	Pace Analytical Services	2	1 Field Duplicate 1 Field Blank 1 Matrix Spike 1 Matrix Spike Duplicate
		TriMatrix Laboratory	1	1 Matrix Spike 1 Matrix Spike Duplicate
		Southwest Laboratory of Oklahoma	2	1 Field Duplicate 1 Field Blank
		Paragon Analytics	1	
	Sediments	Pace Analytical Services	2	1 Field Duplicate
		TriMatrix Laboratories	1	
	Soil	Pace Analytical Services	10	1 Field Duplicate 2 Matrix Spikes
	Air	Air Toxics	11	1 Field Duplicate

Off-schedule 1995 groundwater samples were analyzed for major ions (calcium, potassium, magnesium, sodium, chloride, sulfate, and bicarbonate), nitrate/nitrite, chemical oxygen demand (COD), and radionuclides (gross alpha, gross beta, radium-226, radium-228, uranium-234, uranium-235/236, uranium-238, thorium-228, thorium-230, and thorium-232). Soil samples collected during drilling in 1995 and the drilling water sample were analyzed for parameters appropriate for the location sampled. Five samples from sites PZ-303-AS, SB-01, and SB-02 were analyzed for volatiles by EPA Method 8260, purgeable and extractable hydrocarbons by Method 8015M, and percent moisture by Method 160.3M. Nine samples from sites PZ-300-AD, PZ-300-AS, PZ-302-AS. PZ-302-AI, PZ-304-AS, PZ-304-AI, PZ-305-AI, LR-103 and LR-104 were analyzed for Total Organic Carbon (TOC) by the Walkley-Black Method (Standard Methods of Chemical Analysis, 6th edition, 1963) and percent moisture. Three samples from sites SB-03 and SB-04 were analyzed for purgeable and extractable hydrocarbons by Method 8015M, and percent moisture by Method 160.3M. The drilling water sample was analyzed for volatiles by Method 8260, semivolatiles by Method 8270A, pesticides and PCBs by Method 8080, purgeable and extractable hydrocarbons by Method 8015M, metals by the 6000 series Methods, mercury by Method 7470, inorganics (ammonia, chloride, fluoride, hardness, nitrate/nitrite, total phosphorous, sulfate, sulfide, TOC, total cyanide, COD, and total dissolved solids) by the 100-400 series Methods, and radionuclides (gross alpha, gross beta, radium-226, radium-228, uranium-234, uranium-235/236, uranium-238, thorium-228, thorium-230, and thorium-232) by the 900 series Methods.

Groundwater, surface water, leachate, and sediment samples collected in 1997 were sent to Pace Analytical Services and analyzed for RCRA Subtitle D appendix I volatiles by EPA SW-846 Method 8260A; CLP target compound list semivolatiles by Method 8270; pesticides and poly-chlorinated biphenyls (PCBs) by Method 8081; RCRA Subtitle D appendix I list total metals plus total boron. calcium, iron, magnesium, manganese, mercury, and sodium by the 6010/7000 series Methods; total cyanide by Method 9010; sulfide by Method 9030; and total petroleum hydrocarbons (diesel and gasoline ranges) by Method 8015M. Groundwater and surface water samples were also analyzed for 1,2-dibromoethane and 1,2,3-trichloropropane by Method 8011; bis (2-chloroethyl) ether, 2-nitroaniline, nitrobenzene, n-nitrosodi-n-propylamine, and pentachlorophenol by Method 8000M; benzo(a)pyrene. benzo(a)anthracene. benzo(b)fluoranthene. dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene by Method 8310; hexachlorobenzene and hexachlorocyclopentadiene by Method 8081; RCRA Subtitle D appendix I list dissolved metals plus dissolved boron, calcium, iron, magnesium, manganese, mercury, and sodium by the 6010/7000 series Methods; total organic carbon (TOC) by Method 415.1; chemical oxygen demand (COD) by Method 410.4; and common anions and water quality parameters (ammonia, chloride, fluoride, hardness, nitrate/nitrite, phosphorous, sulfate, and total dissolved solids) by the 100-300 series Methods. Soil samples from borings made to collect air samples were analyzed by Pace, Houston for TOC by Method 13-90-3 (Methods of Soil Analysis, American Society of Agronomy, 2<sup>nd</sup> edition, 1982).

Pace Analytical Services analyzed 48 groundwater samples, eight leachate samples, two surface water samples, two sediment samples, and 10 soil samples. Additional analyses were performed on field duplicates, field blanks, equipment blanks, and matrix spike/matrix spike duplicate samples as listed in Table 10.1.

Eight groundwater (six primary and two field duplicate), one surface water, one sediment, two leachate, and additional QA samples were split and sent to TriMatrix Laboratories for analysis of the same parameters by the same methods as listed above.

Southwest Laboratory of Oklahoma (SWLO) analyzed 48 groundwater, eight leachate, two surface water, and additional QA samples for total and dissolved gross alpha and gross beta by Method 900M; total and dissolved isotopic thorium (Th-230) and uranium (U-234, U-235, and U-238) by Methods 907M and 908M; and total and dissolved radium-226 by Method 903M.

Six groundwater, one surface water, and two leachate samples were split and sent to Paragon Analytics for analysis of the same radiological parameters by the same methods as SWLO, with the exception of radium, which was reported as total radium (radium-226 and radium-228). Total radium was not reported for the three groundwater samples collected during the second sampling round because the high solids content of the samples prevented the accurate determination of chemical recoveries.

Ten air samples and one field duplicate were analyzed by Air Toxics, LTD. for volatile gases by EPA Method TO-14.

#### 10.2 Data validation procedures

Groundwater, surface water, sediment, and leachate sample results for 1997 were reported in Contract Laboratory Program format data packages. All other results were reported without calibration results or raw data. The analytical results were validated using laboratory acceptance criteria and the procedures and guidelines contained in the following documents: National Functional Guidelines for Inorganic Data Review, revised February 1994; National Functional Guidelines for Organic Data Review, revised February 1994; and Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition, November 1986 and revisions.

Items checked for inorganic data packages (if provided) included holding times, initial and continuing calibration results, method and field blank results, ICP interference check sample results, laboratory control sample (LCS) recoveries, spike sample (MS/MSD) recoveries, field duplicate results, compound quantitation, and transcriptions from raw data to the summary forms.

Organic data packages were checked for holding times, instrument performance check, initial and continuing calibration results, method and field blank results, surrogate or system monitoring compound recoveries, matrix spike/matrix spike duplicate and LCS recoveries, internal standard recoveries, field duplicate results, target compound identification, compound quantitation, and transcriptions from raw data to the summary forms.

QA items and raw data missing from the original data packages were requested from the applicable laboratory and added to the data package. Sample results were qualified as estimated detected "J", estimated non-detected "UJ", not detected "U", or unusable "R", based on the guidelines referenced above. The qualifiers have been added to the database and are now a permanent part of the analytical result. The original validated data packages have been retained in the project files.

# 10.3 Precision, accuracy, representativeness, completeness, comparability, and sensitivity

Validation results were reviewed to evaluate the precision, accuracy, representativeness, completeness, comparability, and sensitivity of the analyses.

Precision is a measure of the reproducibility of sample results. It is assessed by tabulating the results of the relative percent differences (RPDs) of matrix spike/matrix spike duplicate (MS/MSD) and laboratory control sample/laboratory control sample duplicate (LCS/LCSD) analyses. RPDs that fall within the QA control limits indicate acceptable precision. The precision numbers reported below indicate the percentage of RPDs for these analyses that fall within the control limits.

Accuracy is the degree of agreement between the measured value and an accepted reference or true value. Accuracy was assessed by evaluation of the percent recoveries for the MS/MSD analyses, laboratory control samples (LCS), surrogates or system monitoring compounds (SMC), and method or preparation blank results. The reported accuracy indicates the percentage of recoveries and blank results within laboratory or method control limits.

Representativeness is the degree to which the data accurately and precisely represent the concentration of target analytes in the samples. Representativeness was assessed by evaluating the RPDs between field duplicate results. The reported representativeness indicates the percentage of RPDs that are within the validation control limits of 20% for aqueous samples (groundwater, surface water, and leachate) and 35% for sediment samples.

Completeness indicates the percentage of valid sample results (results not rejected) obtained from the validation procedures versus the total number of sample results. It was calculated as the number of acceptable results divided by the total number of results.

Comparability expresses the confidence with which one data set can be compared to another. Qualitatively, different data sets can be considered to be comparable if the samples were analyzed following the same analytical methods and validated by the same procedures. The reported comparability indicates the percentage of split sample RPDs that are within the validation control limits of 20% for aqueous samples (groundwater, surface water, and leachate) and 35% for sediment samples.

Sensitivity is the measure of the attainment of the health-based contract-required method detection limits (CRDLs). It was calculated as the number of sample results with detection limits that meet the CRDLs divided by the total number of sample results for analytes that have CRDLs specified.

#### 10.3.1 Precision

The overall project precision, based on the percentage of MS/MSD and LCS/LCSD RPD results within control limits, was 95.6%. Precision of data was 94.1% for Pace Analytical Services, 97.1% for TriMatrix Laboratories, and 100% for Quanterra Laboratory. Precision cannot be calculated for the radiological analyses because the laboratories do not use RPD results as acceptance criteria for duplicate analyses and the analyses do not take estimated error into account. Precision cannot be calculated for the air results because no duplicate spike analyses were performed.

# 10.3.2 Accuracy

The overall project accuracy, based on the percentage of MS/MSD, LCS, surrogate or system monitoring compound, and method or preparation blank results within control limits, was 97.6%. Accuracy of data for each laboratory was 96.8% for Pace Analytical Services, 98.9% for TriMatrix Laboratories, 94.3% for Southwest Laboratory of Oklahoma (SWLO), 87.9% for Paragon Analytics, 99.5% for Quanterra Laboratory, and 99.0% for Air Toxics. Samples for the total radium analyses conducted by Paragon Analytics during the first sampling round were inadvertently filtered and, therefore, these sample results should be considered to be biased low.

#### 10.3.3 Representativeness

The overall project representativeness, based on the percentage of field duplicate RPDs within the validation control limits, was 95.5%. Representativeness for each laboratory was 96.8% for Pace Analytical Services, 99.0% for TriMatrix Laboratories, 57.1% for Southwest Laboratory of Oklahoma, 59.3% for Paragon Analytics, and 100% for Air Toxics. Representativeness by media was 95.7% for groundwater, 96.2% for surface water, 88.8% for sediments, 99.4% for leachates, and 100% for air. The low representativeness of the radionuclide results from Southwest Laboratory of Oklahoma and Paragon Analytics is a function of the very low activities present at the site. Results were near the minimum detectable activities, which caused variability between the original sample and the field duplicate sample result.

## 10.3.4 Completeness

The overall project completeness, defined as the percentage of data not rejected, was 97.1%. Completeness for each laboratory was 96.9% for Pace Analytical Services, 96.6% for TriMatrix Laboratories, 100% for both Southwest Laboratory of Oklahoma and Paragon Analytics, 99.8% for Quanterra, and 95.7% for Air Toxics. Paragon Analytics achieved 100% completeness for the first sampling round despite inadvertently filtering the total radium samples because these results were not rejected. Rather, the filtered radium results are considered to be acceptable as supplemental dissolved radium values.

Completeness by media was 96.6% for groundwater samples, 97.6% for surface water samples, 99.4% for sediment samples, 98.0% for leachate samples, 100% for soil samples, and 95.7% for air samples. The completeness goals for each of these media, as specified in the QAAP, are 95% for groundwater, 80% for surface water, 80% for sediments, 95% for subsurface soil samples, and 95% for landfill gas (air) samples. A completeness goal for the leachate samples was not specified.

## 10.3.5 Comparability

The overall project comparability, based on the percentage of split sample RPDs within the validation control limits, was 89.1%. Comparability by media was 89.6% for groundwater sample pairs, 88.2% for surface water sample pairs, 95.8% for sediment sample pairs, and 84.1% for leachate sample pairs.

Comparability of the non-radiological analyses was 92.9% overall and 90.3% for groundwater, 91.4% for surface water, 95.8% for sediments, and 87.6% for leachates. For the radiological analyses, comparability was 31.6% overall and 36.9% for groundwater, 21.4% for surface water, and 12.5% for leachates. Radiological analyses were not performed on the sediment samples. The low comparability of the radionuclide results is a function of the very low activities present at the site. Results were near the minimum detectable activities, which caused variability between laboratories.

#### 10.3.6 Sensitivity

The overall project sensitivity, based on the number of sample results that met the health-based contract-required method detection limits, was 99.5%. For non-radiological analyses, the sensitivity for Pace Analytical Services was 100%, and the sensitivity for TriMatrix Laboratories was 98.9%. For the radiological analyses, the sensitivity was 93.7% for Southwest Laboratory of Oklahoma and 100% for Paragon Analytics.

Sensitivity by media was 99.5% for groundwater samples, 99.9% for surface water samples, and 100% for sediment samples. Health-based detection limits were not established for the leachate, soil, or air samples.

## 10.4 Resampling of PZ-303-AS

To provide the best possible suite of data from which to characterize OU-2 site conditions, a third groundwater sample was collected from PZ-303-AS. This additional sample was collected in March 1997, and was analyzed for pesticides/PCBs. The additional sampling was undertaken because of discrepancies in PCB results for PZ-303-AS between the primary laboratory and split laboratory based on the February 1997 samples. The split laboratory detected two PCBs in the February 1997 sample collected from PZ-303-AS. The split laboratory detected Arochlor-1248 and Arochlor-1260 in the February 1997 sample, at concentrations of 0.025 mg/l and 0.0087 mg/l respectively. The primary laboratory did not detect any PCBs in the February 1997 PZ-303-AS sample, at a reporting limit of 0.0005 mg/l. The March 1997 resample included both filtered (dissolved) and unfiltered (total) pesticide/PCB analyses. The split laboratory did not detect any pesticides/PCBs in the filtered (dissolved) resample, but detected arochlor-1248 at a concentration of 0.0012 mg/l in the unfiltered (total) sample. Consistent with the February 1997 sample, the primary laboratory did not detect any pesticides or PCBs in the resamples, either as filtered or unfiltered. The primary laboratory maintained a PCB reporting limit of 0.0005 mg/l for the resamples, which is lower than the reported Arochlor-1248 concentration from the split laboratory. The baseline risk assessment will properly incorporate the results of the primary and split laboratory PCB results.

#### 10.5 Summary

The data quality objectives for the OU-2 RI were met by generating defensible, reliable data that can confidently be used to assess the risks posed by the site. All project goals for data completeness were met.

# 11 SUMMARY

The OU-2 RI was conducted to characterize the affected media, location, types, and physical state, and concentration of contaminants, and to describe the extent of contaminant migration. The OU-2 objectives were met by defining site physical and biological characteristics, site hydrogeologic characteristics, sources of contamination, surface and sediment quality, and air quality. Site physical characteristics were presented in detail in the *Physical Characterization Memorandum* previously submitted to EPA. Site biological characteristics were sufficiently defined by OU-1 RI activities. Site hydrogeologic characteristics described in the *Physical Characterization Memorandum* were supplemented with detailed groundwater quality assessment. Source characterization activities included installation of leachate risers to characterize leachate quality in the active and inactive landfills, as well as landfill gas analyses conducted as part of health and safety monitoring and by the analytical laboratory. Surface water and sediment sampling provided reliable data regarding potential groundwater impact on adjacent surface waters and sediments.

Based on the extensive data collected as part of the OU-2 RI, no hazardous substance source areas were identified. The active sanitary landfill maintains an inward hydraulic gradient, drawing surrounding groundwater into leachate collection sumps. The inactive landfill leachate quality is similar to the active sanitary landfill leachate quality and does not include solvent compounds that might be associated with disposal of hazardous substances. Landfill gas in the inactive landfill is typical of solid waste landfills.

Groundwater quality in the Deep Salem and St. Louis/Upper Salem hydrogeologic units near and within OU-2 is similar to upgradient, background groundwater quality, indicating a lack of impacts to these units. With the exception of a limited area along the western portion of the inactive landfill near the monitoring well MW-F2 area west of the asphalt plant LUST site, and selected locations within the site boundaries, the alluvial groundwater quality near the site is also similar to upgradient, background quality. Volatile organic compounds, useful indicators of liquid hazardous substance disposal and solid waste leachate/gas impacts, were detected only infrequently and at low concentrations. Landfill gas has been documented to affect groundwater quality in at least one well, and probably influences groundwater quality throughout the site area. An isolated area in the southwestern portion of the site, near the monitoring well MW-F2 area west of the asphalt plant LUST site, exhibited a wider range of volatile organic compounds and petroleum hydrocarbons, suggesting potential impacts.

Surface water and sediment results indicate that groundwater is not significantly impacting downgradient surface waters and sediments, including the area immediately downgradient of the MW-F2 area.

Summary

Quality assurance results, including field quality assurance such as equipment blanks, field blanks, trip blanks, and field duplicate samples; split laboratory results; and, internal laboratory quality assurance samples such as matrix spikes and matrix spike duplicates indicate that a high level of confidence can be placed on the data generated during the OU-2 RI.

The goals of the OU-2 RI have been met. The baseline risk assessment to be performed using these data can be relied upon to accurately characterize the potential risks posed by the site.

## **REFERENCES**

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References

# APPENDIX A

Drilling water sample analytical results



#### WESTLAKE - DW

WO #: A59LC119

DATE SAMPLED: 6/28/95 LAB #: A5F300050-001 TIME SAMPLED: 15:30

DATE RECEIVED: 6/29/95 MATRIX: WATER 

PARAMETER	RESULT (uq/L)	REPORTING LIMIT	METHOD	EXTRACTION- ANALYSIS DATE	QC <u>BATCH</u>
Chloromethane	ND	1.0	SW846 8260	07/06/95	518804
Bromomethane	ND	1.0	SW846 8260	07/06/95	518804
Vinyl chloride	ND	1.0	SW846 8260	07/06/95	518804
Chloroethane	ND	1.0	SW846 8260	07/06/95	518804
Methylene chloride	ND	1.0	SW846 8260	07/06/95	518804
Acetone	ND	10	SW846 8260	07/06/95	518804
Carbon disulfide	ND	1.0	SW846 8260	07/06/95	518804
1,1-Dichloroethene	ND	1.0	SW846 8260	07/06/95	518804
1,1-Dichloroethane	ND	1.0	SW846 8260	07/06/95	518804
Chloroform	5.1	1.0	SW846 8260	07/06/95	518804
1,2-Dichloroethane	ND	1.0	SW846 8260	07/06/95	518804
2-Butanone	ND	10	SW846 8260	07/06/95	518804
1,1,1-Trichloroethane	ND	1.0	SW846 8260	07/06/95	518804
Carbon tetrachloride	ND	1.0	SW846 8260	07/06/95	518804
Bromodichloromethane	ND	1.0	SW846 8260	07/06/95	518804
1,2-Dichloropropane	ND	1.0	SW846 8260	07/06/95	518804
cis-1,3-Dichloropropene	ND	1.0	SW846 8260	07/06/95	518804
Trichloroethene	ND	1.0	SW846 8260	07/06/95	518804
Dibromochloromethane	ND	1.0	SW846 8260	07/06/95	518804
1,1,2-Trichloroethane	ND	1.0	SW846 8260	07/06/95	518804
Benzene	ИD	1.0	SW846 8260	07/06/95	518804
trans-1,3-Dichloropropene	ND	1.0	SW846 8260	07/06/95	518804
Bromoform	ND	1.0	SW846 8260	07/06/95	518804

SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE LIMITS
Dibromofluoromethane	98	( 86 - 118)
Toluene-d8	100	( 88 - 110)
Bromofluorobenzene	92	( 86 - 115)

NOTE: AS RECEIVED



## WESTLAKE - DW

WO #: A59LC119 DATE SAMPLED: 6/28/95
LAB #: A5F300050-001 TIME SAMPLED: 15:30

LAB #: A5F300050-001 TIME SAMPLED: 15:30
MATRIX: WATER DATE RECEIVED: 6/29/95

		MS Volatiles OF 3			
	RESULT	REPORTING		EXTRACTION-	QC
PARAMETER	(ug/L)	LIMIT	METHOD	ANALYSIS DATE	BATCH
4-Methyl-2-pentanone	ND	10	SW846 8260		5188040
2-Hexanone	ND	10	SW846 8260	07/06/95	5188040
Tetrachloroethene	ND	1.0	SW846 8260	07/06/95	5188040
Toluene	ND	1.0	SW846 8260	07/06/95	5188040
1,1,2,2-Tetrachloroethane	ND	1.0	SW846 8260		5188040
Chlorobenzene	ND ·	1.0	SW846 8260	07/06/95	5188040
Ethylbenzene	ND	1.0	SW846 8260		5188040
Styrene	ND	1.0	SW846 8260		5188040
Xylenes, Total	ND '	1.0	SW846 8260	07/06/95	5188040
Bromochloromethane	ND	1.0	SW846 8260		5188040
1,2-Dibromo-3-chloro- propane	ND.	1.0	SW846 8260	07/06/95	5188040
1,2-Dibromoethane	ND	1.0	SW846 8260	07/06/95	5188040
Dibromomethane	ND	1.0	SW846 8260	, ,	5188040
1,2-Dichlorobenzene	ND .	1.0	SW846 8260		5188040
1,4-Dichlorobenzene	ND	1.0	SW846 8260	07/06/95	5188040
cis-1,2-Dichloroethene	ND	1.0	SW846 8260		5188040
trans-1,2-Dichloroethene	ND .	1.0	SW846 8260	• •	5188040
1,1,1,2-Tetrachloroethane	ND	1.0	SW846 8260	07/06/95	5188040
Trichlorofluoromethane	ND	1.0	SW846 8260		5188040
1,2,3-Trichloropropane	ND .	1.0	SW846 8260	· ·	5188040
Iodomethane	ND	1.0	SW846 8260	07/06/95	5188040
trans-1,4-Dichloro- 2-butene	ND	1.0	SW846 8260	07/06/95	5188040
Vinyl acetate	ND	10	SW846 8260	07/06/95	518804C
SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE	LIMITS		
Dibromofluoromethane	98	( 86 - 1			
Toluene-d8	. 100	( 88 - 1	•		
Bromofluorobenzene	92	( 86 - 1	15)		
		DKV.			

DKV 1,)2,/97

NOTE: AS RECEIVED



WESTLAKE - DW

WO #: A59LC119 DATE SAMPLED: 6/28/95
LAB #: A5F300050-001 TIME SAMPLED: 15:30

MATRIX: WATER DATE RECEIVED: 6/29/95

3 OF 3

PARAMETER RESULT REPORTING EXTRACTION- QC

LIMIT METHOD ANALYSIS DATE BATCH

Acrylonitrile ND 10 SW846 8260 07/06/95 5188040

DKJ 11/21/47

SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE LIMITS
Dibromofluoromethane	98	( 86 - 118)
Toluene-d8	100	( 88 - 110)
Bromofluorobenzene	92	( 86 - 115)

NOTE: AS RECEIVED



WESTLAKE - DW

WO #: A59LC10R

LAB #: A5F300050-001

MATRIX: WATER

DATE SAMPLED:

6/28/95

TIME SAMPLED:

15:30

DATE RECEIVED:

6/29/95

RESULT PARAMETER

REPORTING (ug/L) LIMIT

METHOD

EXTRACTION-ANALYSIS DATE BATCH

QC

Total Petroleum Hydrocarbons-Purgeable

ND UJ 100 SW846 8015A 07/25/95

5209052

NOTE: AS RECEIVED



## WESTLAKE - DW

WO #: A59LC10T

LAB #: A5F300050-001

MATRIX: WATER

DATE SAMPLED: 6/28/95

TIME SAMPLED: 15:30

DATE RECEIVED: 6/29/95

~	-	GC/MS	Semi-Volatiles	-
-	-	GC/MS	Semi-Volatiles	-

1 OF 4							
	RESULT	REPORTING		EXTRACTION-	QC		
PARAMETER	(ug/L)	LIMIT	METHOD	ANALYSIS DATE	BATCH		
Chrysene	ND	10	SW846 8270A	07/02-07/10/95			
Dibenzo(a,h)anthracene	ND	10	SW846 8270A	07/02-07/10/95			
Dibenzofuran	ND	10	SW846 8270A	07/02-07/10/95	5183007		
Di-n-butyl phthalate	ND	10	SW846 8270A	07/02-07/10/95			
1,3-Dichlorobenzene	ND	10	SW846 8270A	07/02-07/10/95			
3,3'-Dichlorobenzidine	ND	20	SW846 8270A	07/02-07/10/95	5183007		
Diethyl phthalate	ND	10	SW846 8270A	07/02-07/10/95			
Anthracene	ND	10	SW846 8270A	07/02-07/10/95	5183007		
4-Chlorophenyl phenyl ether	ND	10	SW846 8270A	07/02-07/10/95	5183007		
Benzo(a) anthracene	ND	10	SW846 8270A	07/02-07/10/95			
Benzo(b)fluoranthene	ND	10	SW846 8270A	07/02-07/10/95			
Benzo(k) fluoranthene	ND	10	SW846 8270A	07/02-07/10/95	5183007		
Benzo(g,h,i)perylene	ND	10	SW846 8270A	07/02-07/10/95			
Benzo(a)pyrene	ND	10	SW846 8270A	07/02-07/10/95			
bis(2-Chloroethoxy)methane	ND	10	SW846 8270A	07/02-07/10/95	5183007		
bis(2-Chloroethyl)ether	ND .	10	SW846 8270A	07/02-07/10/95			
bis(2-Ethylhexyl)phthalate	1.7 B J []	. 10	SW846 8270A	07/02-07/10/95			
4-Bromophenyl phenyl ether	ND	10	SW846 8270A	07/02-07/10/95	5183007		
Butyl benzyl phthalate	ND	10	SW846 8270A	07/02-07/10/95	518300		
Carbazole	ND.	10	SW846 8270A	07/02-07/10/95	518300		
4-Chloroaniline	ND	10	SW846 8270A	07/02-07/10/95	518300.		
2-Chloronaphthalene	ND	10	SW846 8270A	07/02-07/10/95			
Acenaphthene	ND	10	SW846 8270A	07/02-07/10/95	518300		

DKV 11/21/97

	"1-1"/				
SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE LIMITS			
Nitrobenzene-d5	41	( 36 - 148)			
2-Fluorobiphenyl	41	( 38 - 106)			
Terphenyl-d14	66	( 10 - 169)			
Phenol-d5	30	( 15 - 126)			
2-Fluorophenol	20	( 17 - 106)			
2,4,6-Tribromophenol	50	( 13 - 145)			

#### NOTE: AS RECEIVED

- ESTIMATED VALUE. (DETECTED), BUT BELOW QUANTITATION LIMIT.
- B (COMPOUND DETECTED IN METHOD BLANK ASSOCIATED WITH THIS SAMPLE)



#### WESTLAKE - DW

WO #: A59LC10T DATE SAMPLED: 6/28/95
LAB #: A5F300050-001 15:30

MATRIX: WATER DATE RECEIVED: 6/29/95

2 OF 4								
	RESULT	REPORTING		EXTRACTION-	QC			
<u>PARAMETER</u>	(uq/L)	LIMIT	METHOD	ANALYSIS DATE	BATCH			
Acenaphthylene	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Dimethyl phthalate	ND	10	SW846 8270A	07/02-07/10/95				
2,4-Dinitrotoluene	ND	10	SW846 8270A	07/02-07/10/95				
·								
2,6-Dinitrotoluene	ND	10	SW846 8270A	07/02-07/10/95				
Di-n-octyl phthalate	ND .	10	SW846 8270A					
Fluoranthene	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Fluorene	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Hexachlorobenzene	ND	10	SW846 8270A	07/02-07/10/95				
Hexachlorobutadiene	ND	10	SW846 8270A	07/02-07/10/95				
nexaciioi obutadiene	ND	10	511040 027011	0,,02 0,,10,55	3103007			
Hexachlorocyclopentadiene	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Hexachloroethane	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Indeno(1,2,3-cd)pyrene	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Isophorone	ND	10	SW846 8270A	07/02-07/10/95	5183007			
2-Methylnaphthalene	ND .	10	SW846 8270A					
Naphthalene	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Nitrobenzene	ND	10	SW846 8270A	07/02-07/10/95	5183007			
2-Nitroaniline	ND .	50	SW846 8270A	· · · · · · · · · · · · · · · · · · ·				
3-Nitroaniline	ND .	50	SW846 8270A	07/02-07/10/95				
3-NICIOANIIIINE	ND	50	SW040 0270A	01/02-01/10/93	3103007			
4-Nitroaniline	ND	50	SW846 8270A	07/02-07/10/95				
N-Nitrosodiphenylamine	ND .	10	SW846 8270A					
N-Nitrosodi-n-propylamine	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Phenanthrene	ND	10	SW846 8270A	07/02-07/10/95	5183007			
Pyrene	ND	10	SW846 8270A					
Tyrene	DKY	2/47	5,1040 027011	07,02 07,10,33	3283007			
SURROGATE RECOVERY	*	ACCEPTABLE	E LIMITS					
Nitrobenzene-d5	41	( 36 - :	148)					
2-Fluorobiphenyl	41	( 38 - 3						
Terphenyl-d14	66	( 10 - :						
Phenol-d5	30	(15 - 3	=					
2-Fluorophenol	20	(17 - )						
2,4,6-Tribromophenol	50	( 13 - :						
a, a, o in the omobile ito	50	( 13	.L = J /	•				

NOTE: AS RECEIVED



WESTLAKE - DW

WO #: A59LC10T

DATE SAMPLED:

6/28/95

LAB #: A5F300050-001

TIME SAMPLED:

15:30

MATRIX: WATER

DATE RECEIVED:

6/29/95

3 OF 4

RESULT REPORTING (uq/L) LIMIT

EXTRACTION- QC

PARAMETER

METHOD

ANALYSIS DATE BATCH

1,2,4-Trichlorobenzene

ND 10 SW846 8270A 07/02-07/10/95 5183007

SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE LIMITS			
Nitrobenzene-d5	41	( 36 - 148)			
2-Fluorobiphenyl	41	( 38 - 106)			
Terphenyl-d14	66	( 10 - 169)			
Phenol-d5	30	( 15 - 126)			
2-Fluorophenol	20	( 17 - 106)			
2,4,6-Tribromophenol	50	( 13 - 145)			

NOTE: AS RECEIVED



#### WESTLAKE - DW

WO #: A59LC10T

DATE SAMPLED: 6/28/95 LAB #: A5F300050-001 TIME SAMPLED: 15:30

DATE RECEIVED: MATRIX: WATER 6/29/95

4 OF 4							
	RESULT	REPORTING		EXTRACTION-	QC		
PARAMETER	(uq/L)	LIMIT	METHOD	ANALYSIS DATE	<u>BATCH</u>		
4-Chloro-3-methylphenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
2-Chlorophenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
2,4-Dichlorophenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
2,4-Dimethylphenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
2,4-Dinitrophenol	ND	50	SW846 8270A	07/02-07/10/95	5183007		
4,6-Dinitro-	ND	50	SW846 8270A	07/02-07/10/95	5183007		
2-methylphenol							
2-Methylphenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
4-Methylphenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
2-Nitrophenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
4-Nitrophenol	ND	50	SW846 8270A	07/02-07/10/95	5183007		
Pentachlorophenol	ND.	50	SW846 8270A	07/02-07/10/95	5183007		
Phenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
2,4,5-Trichlorophenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
2,4,6-Trichlorophenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		
bis(2-Chloroisopropyl)ether	ND	10	SW846 8270A	07/02-07/10/95	5183007		
3-Methylphenol	ND	10	SW846 8270A	07/02-07/10/95	5183007		

<u>*</u>	ACCEPTABLE LIMITS
41	( 36 ~ 148)
41	( 38 ~ 106)
66	( 10 ~ 169)
30	( 15 ~ 126)
20	( 17 - 106)
50	( 13 ~ 145)
	41 41 66 30 20

NOTE: AS RECEIVED



#### WESTLAKE - DW

WO #: A59LC10Q

LAB #: A5F300050-001

MATRIX: WATER 

DATE SAMPLED: 6/28/95 TIME SAMPLED: 15:30 DATE RECEIVED: 6/29/95

	1	OF 2			
	RESULT	REPORTING		EXTRACTION-	QC
PARAMETER	(uq/L)	LIMIT	METHOD	ANALYSIS DATE	BATCH
alpha-BHC	ND	0.050	SW846 8080	07/02-07/11/95	
beta-BHC	ND	0.050	SW846 8080	07/02-07/11/95	
delta-BHC	ND	0.050	SW846 8080	07/02-07/11/95	5183009
gamma-BHC (Lindane)	ND	0.050	SW846 8080	07/02-07/11/95	5183009
Heptachlor	ND	0.050	SW846 8080	07/02-07/11/95	
Aldrin	ND	0.050	SW846 8080	07/02-07/11/95	
Alulii	ND	0.030	34040 0000	01/02-01/11/55	3183009
Heptachlor epoxide	ND	0.050	SW846 8080	07/02-07/11/95	5183009
Endosulfan I	ND	0.050	SW846 8080	07/02-07/11/95	5183009
Dieldrin	ND	0.10	SW846 8080	07/02-07/11/95	5183009
			g.,,,,,,,	05/00 05/00/05	
4,4'-DDE	ND	0.10	SW846 8080	07/02-07/11/95	
Endrin	ND	0.10	SW846 8080	07/02-07/11/95	
Endosulfan II	ND	0.10	SW846 8080	07/02-07/11/95	5183009
4,4'-DDD	ND	0.10	SW846 8080	07/02-07/11/95	5183009
Endosulfan sulfate	ND	0.10	SW846 8080	07/02-07/11/95	
4,4'-DDT	ND	0.10	SW846 8080	07/02-07/11/95	
1,1 221					
Methoxychlor	ND	0.50	SW846 8080	07/02-07/11/95	5183009
Endrin ketone	ND	0.10	SW846 8080	07/02-07/11/95	5183009
Endrin aldehyde	ND	0.10	SW846 8080	07/02-07/11/95	5183009
alpha-Chlordane	ND	0.50	SW846 8080	07/02-07/11/95	E1 02000
gamma-Chlordane	ND	0.50	SW846 8080	07/02-07/11/95	
Toxaphene	ND ND	1.0	SW846 8080	07/02-07/11/95	
loxaphene	ND	1.0	3#846 6060	07/02-07/11/93	219300:
Aroclor-1016	ND	0.50	SW846 8080	07/02-07/11/95	
Aroclor-1221	ND ,	0.50	SW846 8080	07/02-07/11/95	5183009
	DEN	21/97			
SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE	LIMITS		
Dibutylchlorendate	95	( 10 - 1	55)		
Tetrachloro-m-xylene	119	( 14 - 1	55)		
-					

NOTE: AS RECEIVED



WESTLAKE - DW

 WO #: A59LC10Q
 DATE SAMPLED: 6/28/95

 LAB #: A5F300050-001
 TIME SAMPLED: 15:30

MATRIX: WATER DATE RECRIVED: 6/29/95

PARAMETER	RESULT (uq/L)	REPORTING LIMIT	<u>METHOD</u>	EXTRACTION- ANALYSIS DATE	QC <u>BATCH</u>
Aroclor-1232	ND	0.50	SW846 8080	07/02-07/11/95	
Aroclor-1242	ND	0.50	SW846 8080	07/02-07/11/95	5183009
Aroclor-1248	ND	0.50	SW846 8080	07/02-07/11/95	5183009
Aroclor-1254	ND	0.50	SW846 8080	07/02-07/11/95	5183009
Aroclor-1260	ND	0.50	SW846 8080	07/02-07/11/95	5183009

DKV 11/2/97

SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE LIMITS
Dibutylchlorendate	95	( 10 - 155)
Tetrachloro-m-xylene	119	( 14 - 155)

NOTE: AS RECEIVED



WESTLAKE - DW

WO #: A59LC10P DATE SAMPLED: 6/28/95
LAB #: A5F300050-001 TIME SAMPLED: 15:30

MATRIX: WATER DATE RECEIVED: 6/29/95

RESULT REPORTING EXTRACTION- QC
PARAMETER (ug/L) LIMIT METHOD ANALYSIS DATE BATCH

TPH (Extractables) ND 100 SW846 8015A 07/02-07/07/95 5183010

DKN 11/21/97

NOTE: AS RECEIVED



#### WESTLAKE - DW

WO #: A59LC

DATE SAMPLED: TIME SAMPLED:

6/28/95

LAB #: A5F300050-001

15:30

MATRIX: WATER

DATE RECEIVED:

6/29/95

REQUES	TED :	METALS
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PARAMETER	RESULT	REPORTING LIMIT	UNIT	<u>METHOD</u>	PREPARATION - ANALYSIS DATE	QC <u>BATCH</u>
Silver	ND	10.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Barium	23.0	10.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Beryllium	ND	5.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Boron	ND	100	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Calcium	24,400	5,000	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Cadmium	ND	10.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Cobalt	ND	50.0	ug/L	SW846 6010A	7/07~ 7/12/95	5188021
Chromium	ND	20.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Copper	ND ·	10.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Iron	2,720	50.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Magnesium	11,800	5,000	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Manganese	37.0	10.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Sodium	20,800	5,000	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Nickel	ND	40.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Vanadium	ND	50.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Zinc	ND	50.0	ug/L	SW846 6010A	7/07- 7/12/95	5188021
Mercury	ND	0.20	ug/L	SW846 7470	7/07- 7/10/95	5188021
Arsenic	ND	5.0	ug/L	SW846 6010A	7/07- 7/16/95	5188021
Lead	ND	3.0	ug/L	SW846 6010A	7/07- 7/16/95	5188021
Antimony	ND	5.0	ug/L	SW846 6010A	7/07- 7/16/95	5188021
Selenium	ND	5.0	ug/L	SW846 6010A	7/07- 7/16/95	5188021
Thallium	ND -	10.0	ug/L	SW846 6010A	7/07- 7/16/95	518802:

NOTE: AS RECEIVED



## WESTLAKE - DW

WO #: A59LC

DATE SAMPLED:

6/28/95

LAB #: A5F300050-001 MATRIX: WATER

TIME SAMPLED:

15:30

DATE RECEIVED:

6/29/95

PARAMETER	RESULT	REPORTING LIMIT	<u>UNIT</u>	METHOD	PREPARATION - ANALYSIS DATE	QC <u>BATCH</u>
Hardness Total Dissolved Solids	98 250	5 10	mg/L mg/L	MCAWW 130.2 MCAWW 160.1	7/14/95 7/03- 7/05/95	5198051 5184103
Chloride	19	2	mg/L	MCAWW 325.2	7/18/95	5199056
Fluoride	1.0	0.1	mg/L	MCAWW 340.2	7/11/95	5192040
Nitrate-Nitrite	1.4	0.1	mg/L	MCAWW 353.2	7/07/95	5193020
Phosphorous, Total	0.1	0.1	mg/L	MCAWW 365.2	7/18- 7/19/95	5199053
Carbon, Total Organic	3	1	mg/L	MCAWW 415.1	7/12/95	5194014
Sulfide	3	1	mg/L	SW846 9030A	7/03/95	5184094
Nitrogen, Ammonia	1,	0.2	mg/L	MCAWW 350.3	7/15/95	5196010
Cyanide, Total	ND	0.005	mg/L	SW846 9010A	7/11- 7/12/95	5192012
Sulfate	85	25	mg/L	MCAWW 375.4	7/19/95	5201003
Chemical Oxygen Demand	28	20	mg/L	MCAWW 410.4	7/13/95	5194078

NOTE: AS RECEIVED



## TRIP BLANK

WO #: A59LK101 DATE SAMPLED: 6/28/95

LAB #: A5F300050-002 ... TIME SAMPLED:

MATRIX: WATER DATE RECEIVED: 6/29/95

		MS Volatiles	<del>-</del>		
	1 ( RESULT	OF 3 REPORTING		EXTRACTION-	QC
PARAMETER	(ug/L)	LIMIT	METHOD	ANALYSIS DATE	BATCH
INGUITA					
Chloromethane	ND	1.0	SW846 8260	07/06/95	5188040
Bromomethane	ND	1.0	SW846 8260	07/06/95	5188040
Vinyl chloride	ND	1.0	SW846 8260	07/06/95	5188040
Chloroethane	ND	1.0	SW846 8260	07/06/95	5188040
Methylene chloride	ND	1.0	SW846 8260	07/06/95	5188040
Acetone	ND	10	SW846 8260	07/06/95	5188040
Carbon disulfide	ND	1.0	SW846 8260	07/06/95	5188040
1,1-Dichloroethene	ND	1.0	SW846 8260	07/06/95	5188040
1,1-Dichloroethane	ND	1.0	SW846 8260	07/06/95	5188040
Chloroform	ND	1.0	SW846 8260	07/06/95	5188040
1,2-Dichloroethane	ND	1.0	SW846 8260	07/06/95	5188040
2-Butanone	ND	10	SW846 8260	07/06/95	5188040
1,1,1-Trichloroethane	ND	1.0	SW846 8260	07/06/95	5188040
Carbon tetrachloride	ND	1.0	SW846 8260	07/06/95	5188040
Bromodichloromethane	ND	1.0	SW846 8260	07/06/95	5188040
1,2-Dichloropropane	ND	1.0	SW846 8260	07/06/95	5188040
cis-1,3-Dichloropropene	ND	1.0	SW846 8260	07/06/95	5188040
Trichloroethene	ND	1.0	SW846 8260	07/06/95	5188040
Dibromochloromethane	ND	1.0	SW846 8260	07/06/95	5188040
1,1,2-Trichloroethane	ND	1.0	SW846 8260	07/06/95	5188040
Benzene	ND	1.0	SW846 8260	07/06/95	5188040
trans-1,3-Dichloropropene	ND	1.0	SW846 8260	07/06/95	5188040
Bromoform	ND .	1.0	SW846 8260	07/06/95	5188040
	DKW	21/97			
SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE	LIMITS		
Dibromofluoromethane	95	(86 - 1	18)		
Toluene-d8	100	(88 - 1	10)		
Bromofluorobenzene	87	(86 - 1	15)		

NOTE: AS RECEIVED



#### TRIP BLANK

WO #: A59LK101

LAB #: A5F300050-002

MATRIX: WATER

DATE SAMPLED: 6/28/95

TIME SAMPLED:

DATE RECEIVED: 6/29/95

MATRIX: WATER	DATE RECEIVED: 6/29/9					/29/95
		OF 3				
	RESULT	REPORTING			EXTRACTION-	QC
PARAMETER	(ug/L)	LIMIT_	METH	<u>ac</u>	ANALYSIS DATE	BATCH
4-Methyl-2-pentanone	ND	10	SW846	8260	07/06/95	5188040
2-Hexanone	ND	10	SW846	8260	07/06/95	5188040
Tetrachloroethene	ND	1.0	SW846	8260	07/06/95	5188040
Toluene	ND	1.0	SW846	8260	07/06/95	5188040
1,1,2,2-Tetrachloroethane	ND	1.0	SW846	8260	07/06/95	5188040
Chlorobenzene	ND	1.0	SW846	8260	07/06/95	5188040
Ethylbenzene	ND	1.0	SW846	8260	07/06/95	5188040
Styrene	ND	1.0	SW846	8260	07/06/95	5188040
Xylenes, Total	ND	1.0	SW846	8260	07/06/95	5188040
Bromochloromethane	ND	1.0	SW846	8260	07/06/95	5188040
1,2-Dibromo-3-chloro- propane	ND	1.0	SW846	8260	07/06/95	5188040
1,2-Dibromoethane	ND	1.0	SW846	8260	07/06/95	5188040
Dibromomethane	ND	1.0	SW846	8260	07/06/95	5188040
1,2-Dichlorobenzene	ND .	1.0	SW846	8260	07/06/95	5188040
1,4-Dichlorobenzene	ND	1.0	SW846	8260	07/06/95	5188040
cis-1,2-Dichloroethene	ND	1.0	SW846	8260	07/06/95	5188040
trans-1,2-Dichloroethene	ND	1.0	SW846	8260	07/06/95	5188040
1,1,1,2-Tetrachloroethane	ND.	1.0	SW846	8260	07/06/95	5188040
Trichlorofluoromethane	ND	1.0	SW846	8260	07/06/95	5188040
1,2,3-Trichloropropane	ND	1.0	SW846	8260	07/06/95	5188040
Iodomethane	ND.	1.0	SW846	8260	07/06/95	518804(
trans-1,4-Dichloro- 2-butene	ND	1.0	SW846	8260	07/06/95	518804(
Vinyl acetate	ND.	10	SW846	8260	07/06/95	518804(
SURROGATE_RECOVERY	<u>*</u>	ACCEPTABLE	LIMITS			
D/h 61	0.5		>			

DW 11/21/97

( 86 - 118) ( 88 - 110) ( 86 - 115)

95

87

100

NOTE: AS RECEIVED

Toluene-d8

Dibromofluoromethane

Bromofluorobenzene



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WO #: A59LK101

LAB #: A5F300050-002

DATE SAMPLED:

6/28/95

TIME SAMPLED:

MATRIX: WATER

DATE RECEIVED: 6/29/95

3 OF 3

RESULT REPORTING EXTRACTION-QC PARAMETER (ug/L) LIMIT METHOD ANALYSIS DATE BATCH

Acrylonitrile ND 10 SW846 8260 07/06/95 5188040

SURROGATE RECOVERY	<u>*</u>	ACCEPTABLE LIMITS				
Dibromofluoromethane	95	( 86 - 118)				
Toluene-d8	100	( 88 - 110)				
Bromofluorobenzene	87	( 86 - 115)				

NOTE: AS RECEIVED

TRIP BLANK

WO #: A59LK102

DATE SAMPLED:

6/28/95

LAB #: A5F300050-002 MATRIX: WATER

RESULT

TIME SAMPLED: DATE RECEIVED:

6/29/95

REPORTING

EXTRACTION-QC

PARAMETER

(uq/L) LIMIT

METHOD ANALYSIS DATE BATCH

Total Petroleum

Hydrocarbons-Purgeable

UJ 100 SW846 8015A 07/25/95

520905:

NOTE: AS RECEIVED

Project: 614.01

ategory: Isotopic Thorium thod: MAS-NS-3004 rix: Water



Environmental
Services
Report Date: 07/18/95
Date Sampled: 06/28/95
Date Received: 06/20/95

lient ID	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 \${gma Error (+/-)	MOA
-5F290041-001	8769-001	Thorium-232	07/11/95	07/13/95	ND	PC1/L		1.00
A-5F290041-001	8769-001	Thorium-230	07/11/95	07/13/95	ND	PCI/L		1.00
-5F290041-001	87 <del>69</del> -001	Thorium-228	07/11/95	07/13/95	ND	PCI/L		1.00



Project: 614.01



Environmental
Report Date: 07/ Report Dit: 07/18/95
Date Sampled: 06/28/95
Date Received: 06/29/95

category: Isotopic Uranium Tethod: NAS-NS-3050 Prix: Water		Pı	roject:	614.01			Da	port Dite: te Sampled: te Received:	07/18/95 06/28/95		
Client		Quanterra ID	Parameter		Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA	
A-5F290041	1-001	8769-001	Uranium-238		07/11/95	07/14/95	ND	PCI/L		1.00	
A-5F290041	1-001	8769-001	Uranium-235/236		07/11/95	07/14/95	NO	PCI/L		1.00	
A-5F290041	-001	8769-001	Uranium-234		07/11/95	07/14/95	NO	PCI/L		1.00	

Project: 614.01

category: Gross Alpha/Beta

EPA 9310

Water

thod: trixi



Environmental

Services Report Date: 07/18/95

Date Sampled: 06/28/95 Date Received: 06/29/99

client ID	Quanterra ID	Parame'ter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	HDA	
-5F290041-001	8769-001	Gross Alpha	07/09/95	07/12/95	ND	PCI/L		5.00	
A-5F290041-001	8769-001	Gross Beta	07/09/95	07/12/95	5.09	PCI/L	1.36	3.00	

Project: 614.01

category: Radium 226/228 Method: EPA 903.0/904.0 Matrix: Water



Environmental

Services
Report Date: 07/18/95 Date Sampled: 06/28/95 Date Received: 06/29/95

tlient 10	Quanterra ID	Parameter	Prep Date	Date Analyzed	Result	Units	2 Sigma Error (+/-)	MDA	
-5F290041-001	8769-001	Radium-226	07/11/95	07/13/95	ND	PC1/L		1.00	
A-5F290041-001	8769-001	Radium-228	07/11/95	07/13/95	ND $\widehat{\mathcal{K}}$	PCI/L		1.00	

APPENDIX B
Well purging forms

APPENDIX B.1
Well purging forms, February 1997



Sheet 1 of

Locatic	ocation Laidlan/ Westlake Ou-2/MO						
Monitored	itored by:			2/13/	97	Time:	830
Well/Pie	zometer D	ata   2-100-	55	, ,			
Depth of w	vell (from top o	(circle one) of PVC or ground)		95.4	19	feet	
Depth to w	Depth to water (from top of PVC or ground)			72.74 feet			
Radius of c	Radius of casing			inches feet			
Casing Vol	Casing Volume			cubic feet 3.79 gallons			
Develop	pment/Pu	rging Discharge D	ata				
Purging me	thod	••		stants	s steel	poiler	
Start Purgir	ng		Date:	#	2/13	Time:	900
Stop Purging			Date:			Time:	
Monitoring	g						
Date	Time	Volume discharged	Temp	pН	Spec.Cond.	Turbidity	i ''
2/13	0912	(gals)	4 <b>8</b> .0	7.68	(mS/cm)	(NTU)	and comments
2/12	10920	2.5	44.0	7.56	1067	320	slightly cloudy
2//3	0930	7.5	47.2	7.56	1125	315	Cloudy
~//~	1/2 24	9.5	44.1		1001	>1000	disti-bown
12//2	1000			/ /5		10 1000	<u> </u>
2/13	1000	7.5		7,75	i /	1 11	1 1
2//3	1000		Play	,	over late	1 A	1 hancis
2//3	1000	well son dry	ollau	to rec	purer Dark	he body	Jengo
2//3			elsu	,	over lake	he borry	popo
2//3			, ollau	,	pure lake	be barry	jenço
2//3	1000		, Ilau	,	over lak	Le topy	jenço
	Level Rec		, Ilau	,	over lak		Jeng 10
Water I	Level Rec	well son dry	Date:	,	ower lake	Time:	Jempo
	Level Reco	well son dry	Date:	to rec	1 time	] Time:	Water Level (feet)
Start of reco	Level Reco	overy Data	Date:	to rec			Water Level (feet)
Start of reco	Level Reco	overy Data	Date:	to rec	1 time	] Time:	Water Level (feet)
Start of reco	Level Reco	overy Data	Date:	to rec	1 time	] Time:	Water Level (feet)
Start of reco	Level Reco	overy Data	Date:	to rec	1 time	] Time:	Water Level (feet)
Start of reco	Level Reco	overy Data	Date:	to rec	1 time	] Time:	Water Level (feet)
Start of reco	Level Reco	overy Data	Date:	to rec	1 time	] Time:	Water Level (feet)
Start of reco	Level Reco	overy Data	Date:	to rec	1 time	] Time:	Water Level (feet)
Start of reco	Level Reco	overy Data	Date: Clock Time (hh:mm)	to rec	1 time	] Time:	Water Level (feet)
Start of reco	Level Reco	overy Data	Date: Clock Time (hh:mm)	to rec	1 time	] Time:	Water Level (feet)



VA	SSOCIALE	<b>28</b>					Sheet 1 of		
Locatio	n	Laidlaw	/ Westlake	04-2	/mo				
Monitored l	py:	V. Shap	2/13/97 Time:			1520			
Well/Piez	zometer Da	ita $PZ-102R$	- 55				,		
		(circle one)		91.42		٦.			
Depth of we	Depth of well (from top of PVC or ground)					∫feet ∏fæt			
Depth to wa	Depth to water (from top of PVC or ground)				35				
Radius of ca	Radius of casing				inches feet				
0 1 7/1				1.32		_			
Casing Volu	ıme					cubic feet gallons			
Develop	ment/Pur	rging Discharge D	ata						
Purging met	Purging method				Staigless steel bailer				
Start Purging			Date:	2/13		Time:	1520		
Stop Purging			Date:	2/13		Time:	16 15		
Monitoring									
Date	Time	Volume discharged	Temp	pН	Spec.Cond.	Turbidity	Appearance of water		
		(gals)	(F)		(mS/cm)	(מנמ)	and comments		
2/13	1525	1.0	52.9	7.69	1200	422			
	1535	2.5	5/.2	7.60	1220	7,000	17 Choudy		
	1540	2.75	50.6	7.45	1218	71000	7,		
<u> </u>	1550	3.0	49.5	7.67	1170	7/000			
	1415		78.3	7.97	7207	71000	1		
		well rou dr	y olo	W to 12	ecover &	erae so	inglive		
			1	ļ		<i>Y</i>	/		
	ļ			-	<u> </u>	<del> </del>			
Water L		very Data	Date:			Time:			
	reiy					Tune.			
Monitoring		Date	Clock Time (hh:mm)	Elapsed time (mins)		Water Level (feet) Measurement point:			
						1,2			
						(1)/,			
	}					<del>\</del>			
	}			Konth	<u>~~~</u>	<u> </u>			
	}		<del></del>	12	112				
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			10	/1					
				<u> </u>					
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7.46



Sheet 1 of \_\_\_\_\_ Laidlan/ PZ-104-5D Location Westlake Date: Time: Monitored by: Well/Piezometer Data (circle one) 248.6 Depth of well (from top of PVC or ground) feet feet Depth to water (from top of PVC or ground) inches Radius of casing feet cubic feet Casing Volume gallons Development/Purging Discharge Data Purging method Submersible Date: Time! Start Purging Date: Stop Purging Time: Monitoring Date Time Volume discharged Temp Spec.Cond. Turbidity Appearance of water (gals) (mS/cm) (NTU) and comments 2/13/17 1250 1140 50.1 1290 10 46 11470 44 50.6 20 51.0 98 11490 1456 1310 64 M 51.6 1380 75 1517 30 2/13/17 40 20 1400 ラ 8 60 1400 48 2114/17 0830 71) 7 83 1410 48 1370 0901) 75 Water Level Recovery Data Start of recovery Date: Time: Clock Time Monitoring Date Water Level (feet) Elapsed time (hh:mm) (mins) Messurement point:



Sheet 1 of \_\_\_\_\_ PZ-104-55 Laidlan/ Westlake Location 14-2 MO Date: 15:20 Time: Monitored by: 8:15 Well/Piezometer Data (circle one) feet Depth of well (from top of PVC or ground) /39.90 feet /33.80 Depth to water (from top of PVC or ground) Radius of casing inches feet Casing Volume cubic feet 6.83 gallons Development/Purging Discharge Data Stailless steel boiler Purging method Start Purging Date: Time: 15 125 8:15 Stop Purging Date: Time: Monitoring рΉ Turbidity Date Time Volume discharged Temp Spec.Cond. Appearance of water (mS/cm) (DTV) and comments (gals) 187 48.6 759 lack (visible black spe 758 -no specks (well wentern) 52.0 5.0 6.85 948 55.7 5.50 6.75 800 9 45 54.3 801 51.3 309 Water Level Recovery Data Start of recovery Date: Time: Clock Time Water Level (feet) Date Elapsed time Monitoring Measurement point: (hh:mm) (mins)



Sheet 1 of Laidlan/ Westlake PZ-106-51 Location 14-2 MD S.R. Mon Monitored by: Date: Time: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) <u>203.</u> feet 93.12 Depth to water (from top of PVC or ground) feet Radius of casing inches feet cubic feet Casing Volume 17.93 gallons Development/Purging Discharge Data Submersible pump Purging method 2/18/97 1100 Start Purging Date: Time: Stop Purging Date: Time: Monitoring Volume discharged Spec.Cond. Date Time Temp ρН Turbidity Appearance of water (mS/cm) COLLAD (gais) and comments 204  $1i\infty$ 110/ 13 CLEAT 1082 59.7 59.6 9 1105 7.34 1084 1110 10 10 7.45 125 1116 1112 6 7.45 60.0 1115 1104 14 2/18/97 0.0 5 44 149 1146 well rendry Water Level Recovery Data Start of recovery Date: Time: Water Level (feet) Elapsed time Monitoring Date Clock Time (mm:nm) (mins) Measurement point:



Sheet 1 of \_ -106.55 Westlake Location nu-2 MD Date: Time: Monitored by: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) feet Depth to water (from top of PV) or ground) fcct Radius of casing inches fect Casing Volume cubic fœt gallons Development/Purging Discharge Data Purging method 133() Start Purging Date: Time: Stop Purging Date: Time: Monitoring pН Time Volume discharged Temp Spc.Cond. Turbidity Appearance of water Date (gals) (mS/cm) (DIV) and comments 12114117 1500 855 1507 5 <9.1 7.50 10.0 1515 7,40 6D.1 15.0 <u>5.9.8</u> 7.43 940 Water Level Recovery Data Start of recovery Date: Time: Clock Time Water Level (feet) Elapsed time Monitoring Date (hh:mm) (mins) Measurement point:



_							Sheet I of	
Locatio	n	Laidlan	/ Westlake	04-2	Imo		PZ -110-55:	
Monitored b	y:	1754	Date:	2/18/	77	] Time:	<b>76</b> 1500	
Well/Piez	ometer Da	ata					,	
Depth of we	ell (from top o	(circle one) of PVC or ground)		//3 6 feet				
Depth to wa	ter (from top	of PVC or ground)		30.55 feet			46,10	
Radius of ca	sing			Z"		inches feet		
Casing Volu	Casing Volume				5	cubic feet gallons		
Develop	ment/Pu	rging Discharge D	ata				ar.	
Purging met	hod	• •		Grung	16, P-p			
Start Purging			Date:			] Time:	1505	
Stop Purging			Date:	2/18 Time:			1550	
Monitoring				·				
Date	Time	Volume discharged	Temp	pН	Spec.Cond. (mS/cm)	Turbidity	Appearance of water	
2/18	1520	(gals)	(F)	682	1280	(VIV) \$ 2	and comments	
	1525	4	61.8	7.22	1270	9		
	1535	7	G13	9.22	1272	13		
	1545	13	61.5	9.27	1086	13	1	
	73 73	[4]	67.3	7, 50	10/0			
		well zon	dry so	male or	to neco	reuf		
			1	/		1		
	·							
		overy Data	D			~		
Start of recov	cry		Date:			Time:		
Monitoring Date		Date	Clock Time (hh:mm)	Elapsed time (mins) Measur		Measureme	Water Level (feet) int point:	
						1.	11/1/	
	<del> </del>					7.1	114	
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Sheet 1 of P7-100.50 Location Westlake 14-2 MD Date: Time: 12:00 Monitored by: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) feet 114,44 Depth to water (from top of PVC or ground) feet inches Radius of casing feet cubic feet Casing Volume 21.69 gallons Development/Purging Discharge Data Purging method Submersible bailes Start Purging Date: Time: -18-97 N9 30 Stop Purging Date: Time: Monitoring Volume discharged Date Time Temp рΗ Spec.Cond. Turbidity Appearance of water (ध्रवीत) (mS/cm) (NTU) and comments (F) 20 2-17-97 1240 prown-cloude 18 1243 644 7.0 2 ( clear 1750 638 0.0 12.5 60.6 1255 2-119-92 1845 19930 C9. well ron Water Level Recovery Data Start of recovery Date: Time: Date Clock Time Water Level (feet) Monitoring Elapsed time (hh:mm) (mins) Measurement point:



Sheet 1 of Location Westlake P7-111-5D 14-2 MO Date: Time: Monitored by: 1350 Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) 212. feet Depth to water (from top of PVC or ground) 30,28 fœt inches Radius of casing feet Casing Volume 245 cubic feet gallons 79.67 Development/Purging Discharge Data Purging method arvadas pump Start Purging Date: 2/20/97 Time: 1400 Time: Stop Purging Date: Monitoring Date Volume discharged Spec.Cond. Time Temp pН Turbidity Appearance of water (gals) (F) (mS/cm) (DIV) and comments 29 5 7-10-97 1420 58.7 7.5 1008 Cleat 425 58.4 1006 <u>.0</u> 1435 1445 6.95 0.0 59.4 60.8 1028 15.0 7.07 Hydre died 1530 60. Ī 401100 ell ron du Water Level Recovery Data Start of recovery Date: Time: Monitoring Date Clock Time Water Level (feet) Elapsed time (hh:mm) (mins) Measurement point:



Sheet 1 of \_ Location Westlake 04-2 MO Time: Monitored by: Well/Piezometer Data (circle one) 110.3 Depth of well (from top of PVE or ground) feet 29.78 Depth to water (from top of PVC or ground) feet inches Radius of casing feet Casing Volume cubic fæt 13.12 gallons Development/Purging Discharge Data submessible pump Purging method Date: 2/20/97 Time: 1515 Start Purging Date: Time: Stop Purging Monitoring Spec.Cond. Turbidity Appearance of water Volume discharged Temp Date Time (VTV) (mS/cm) and comments (F) 2/2019 900 1525 2070 10 1530 2070 1635 CO. 1540 1550 .04 2030 40 1600 Water Level Recovery Data Date: Time: Start of recovery Water Level (feet) Clock Time Elapsed time Date Monitoring Measurement point: (hh:mm) (mins)



Sheet 1 of \_ Location Westlake MO Date: 1030 Monitored by: Time: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) 41.5 feet Depth to water (from top of Pye or ground) feet Radius of casing inches feet cubic feet Casing Volume gallons Development/Purging Discharge Data Purging method 5th mars in fe -1100 WR 030 Date: Time: Start Purging 1100 Stop Purging Date: Time: Monitoring Volume discharged Spec.Cond. Temp pН Turbidity Appearance of water Date Time (DTM) (mS/cm) and comments (gals) (T) 2.05 2/24/97 5 1145 58.0 1830 30 23.E 1150 6.5 6.86 1700 1770 6.81 8 1123 8 51.7 6.80 54.4 1840 1200 10 Water Level Recovery Data Start of recovery Date: Time: Monitoring Date Clock Time Elapsed time Water Level (feet) (hh:mm) (mins) Measurement point:



Sheet 1 of PZ-113-55 Laidlan/ Westlake Location 04-2 MO 2-19-97 Monitored by: Date: Time: 340 Well/Piezometer Data (circle one) Depth of well (from top of PVC br ground) fect 60.2 Depth to water (from top of PVC or ground) 30.25 fcct inches Radius of casing fect cubic feet Casing Volume gallons 21.18 Development/Purging Discharge Data Purging method Submersible pump 1345 Date: Time: Start Purging 2-19-97 Time: Stop Purging Date: Monitoring Date Time Volume discharged Temp pН Sp∞.Cond. Turbidity Appearance of water (gals) (mS/cm) NTU (F) and comments 2-19-97 1400 1076 720 610 <u> 128</u> 93 1440 605 18 1288 1501 6060 will ren Water Level Recovery Data Start of recovery Date: Time: Clock Time Water Level (feet) Date Elapsed time Monitoring (hh:mm) Measurement point: (mins)



							Sheet 1 of
Locatio	n	Laidlan	/ Wexlake	04-2	1 mo		
Monitored t	by:	17.5hg	Date:	2/13	197	Time:	1120
Well/Pies	zometer Da	ta PZ-2011	A -53	, ,	•		
VV CIDITICA	cometer Du	·	•				•
Depth of we	ell (from top of	(circle one) "PVC or ground)		91.8	71	feet	- 100
Depth to wa	iter (from top c	of PVC or ground)		70.	18	]feet 7-1	1/27
Radius of ca	sing			2		inches	
						feet	
Casing Volu	ıme			3.4	8	cubic feet	
<b>D</b> 1		Dia . b D	1 <b>- 4</b> -				
Develop	menvPur	ging Discharge D	ata				
Purging met	thod	••		5+2:24	n Steel	rgilor	
Start Purgin	g		Date:	2/13/9	7	Time:	1125
Stop Purging	В		Date:			Time:	
Monitoring							
			т —	<del></del>	<del></del>	<u> </u>	
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec.Cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
2/1:		2 5	47.4		960	369	( ) v( , a,
		C. 0	45,5	7,92	969	1000	1 .
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Water L	evel Reco	very Data					
Start of recov	rery		Date:			Time:	
Monitoring	Γ	Date	Clock Time	Elapseo	time		Water Level (feet)
J	<u> </u>		(hh:mm)			Measuremer	
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Sheet 1 of \_\_\_ Laillan Westlake Location MD 14-2 Date: Monitored by: D. She 212 97 Time: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) 91.5 fcct Depth to water (from top of PVC or ground) 64.61 fcct Radius of casing inches fect Casing Volume cubic feet 4.38 gallons Development/Purging Discharge Data Purging method Stainless steel bailer Date: 2/12/97 Start Purging Time: 1515 Date: Time: Stop Purging Monitoring Volume discharged Spec.Cond. Turbidity Date Time Temp ρН Appearance of water (mS/cm) (gals) (DIN) and comments 2.12.97 51.8 \$1540 2.5 1162 85 slightly cloudy 5.0 48.1 1321 514 2.12 5 55 <u>6.5</u> 47.6 1364 710 2.12 1630 Water Level Recovery Data Date: Start of recovery Time: Date Clock Time Elapsed time Water Level (feet) Monitoring (hh:mm) (mins) Measurement point:

70.09

WLMONTNG.XLS

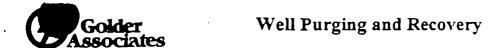


Sheet 1 of 12-206-55 Location Westlake 14-2 MO Time: 1730 MRSTOR Date: Monitored by: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) feet Depth to water (from top of PVO or ground) ſœt Radius of casing inches feet 13.78 Casing Volume cubic feet gallons Development/Purging Discharge Data submersible DUMD Purging method 1230 Start Purging Date: Time: Date: Stop Purging Time: Monitoring Turbidity Volume discharged Sp∞.Cond. Date Time Temp pН Appearance of water (mS/cm) (DTM) (gals) and comments 12.50 1180 7 100 2100 1255 7.40 820 1200 **5** 8 LIW 1/307 1300 22.5 12 1330 11420 11411 525 80 1430 144 7490 at the roundfund Water Level Recovery Data Start of recovery Date: Time: Clock Time Water Level (feet) Date Elapsed time Monitoring (hh:mm) (mins) Measurement point:



Locatio	n [	Laidlan	/ Westlake	04-2	1 mo	P	z-208-55	
Monitored b	y; [	D. Shay	Date:	Z 14	97	Time:	850	
Well/Pi <b>e</b> z	cometer Dat	· 1	<u> </u>	1	I			. j .
lanth of som	ul (from top of)	<i>(circle one)</i> PVC or ground)		100	1 a	feet		,
•	•	PVC or ground)			57	]fcct		
adius of ca	_	1 ve or ground)		2		]inches		
adius of ca	znik					feet		
asing Volu	ıme			9.6	3	cubic fæt gallons		
Pevelop	ment/Purg	ging Discharge D	ata					
urging met	hod	• •	•	Stan	60 stal	beler		
art Purging	3、		Date:	2/14	,	Time:	900	
op Purging	3		Date:			Time:		
onitoring								
Date	Time	Volume discharged	Temp	pН	Spec.Cond.	Turbidity		
2/17	0430	(gals) 5 (;	(F) 4/9 2	7.71	(mS/cm)	NTU	and comments	
2/14	(1950)	5.0 7.5	77.4	7.48	1830	93	clundy	
2/14	#/coc	10.0	47,9	7.44	1840		very claidy	
X/14	1010	12.5	1431.3	7.52	1820	>1005	= 10/20 20	
				1	ΔA			
		well re	n dry,	sangle	of de rece	yorly	<u> </u>	
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ater L	evel Recov	ery Data	Date:			] Time:		:
onitoring		Date	Clock Time	Elapsed	l time		Water Level (feet)	
•			(hh:mm)	(mi		Measureme		
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VAS	SOCIATE	<b>'S</b>					Sheet 1 of
Location	n	Laidlaw/	/ Westlake	04-2	1 mo		301 3- <del>12-</del> 55
Monitored b		1) 54	Date:	2/12/	,	Time:	11:00
	•	7.		211-1			77.00
Well/Piez	ometer Da	ta					
Denth of we	Il (from top of	(circle one) PVC or ground)		163		feet	
-		of PVC or ground)		91.2		]fcct	
Radius of cas		ar a con ground,				inches	
, or on	8					feet	
Casing Volu	me				.7	cubic feet	
					• /	gallons	
Develop	ment/Pur	ging Discharge D	ata				
Purging meth				Stair	1 41	l baile	
			Date:			Time:	11:00
Start Purging			Date:	2/12		Time:	12:45
Stop Purging	<b>(</b>		Date.	2/12	/ 7 /	J Tulie.	12.13
Monitoring							
Date	Time	Volume discharged	Temp	рН	Spec.Cond.	Turbidity	Appearance of water
2/17	11:15	(gals) 2.25	(°F)	6.75	(n/S/cm)	(NTU)	and comments
2,	1130	5.0	50.8	7.19	845	14	
	11 45	7.5	47.1		936	67	getting claudier
	1200	10.0	50.3	7.28	906	183	V
	1230	11.5	20.3	7.20	851	319	
		well ron	A	J. 14	بهد معد		
		well ran	duy, non	yac orun	10 C Brown	7	
<del> </del>		_ <del></del> · · · · · · · · ·	<del>'</del>		<del>/</del>	1	
Water Le	evel Reco	very Data					
Start of recove	ery		Date:			Time: [	
Monitoring	ſ	Date	Clock Time	Elapsed	time		Water Level (feet)
	-		(hh:mm)	(mi	ns)	Measuremen	nt point:
	-			<del></del>		- ( , \	715x
					TT	~ + t	
				11	No.	1	
				Dar	A		
	-			1 20			
	}		70	<del></del>	70		
<b>5</b> .	-			<del></del>			



Sheet 1 of Location Westlake 14-2 MA 0910 Date: Monitored by: Time: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) 28.88 feet Depth to water (from top of PVC or ground) 20.15 fcct Radius of casing inches feet Casing Volume cubic feet 1.4a gallons Development/Purging Discharge Data Purging method DUMD 0970 Start Purging Date: Time: 0930 Stop Purging Time: Date: Monitoring Date Time Volume discharged Temp pН Sp∞c.Cond. Turbidity Appearance of water (gals) (mS/cm) (NTU) and comments (F) 0910 501 58.2 black on hy sheet 0915 441 2900 25 / 01/25/00W 0920 29 26 1289 60.1 2810 2800 1993 1261 0930 2790 94 aler/al, show 6.24 Water Level Recovery Data Start of recovery Date: Time: Clock Time Water Level (feet) Monitoring Date Elapsed time (hh:mm) (mins) Measurement point:



Sheet 1 of Location Westlak MD MRS/ Monitored by: Date: Time: 1320 Well/Piezometer Data (circle one) 30.3 Depth of well (from top of PVC or ground) feet 22,06 Depth to water (from top of PVC or ground) feet Radius of casing linches feet Casing Volume cubic feet 34 gallons Development/Purging Discharge Data mers, ble Purging method Date: 1356 Time: Start Purging Date: Time: Stop Purging Monitoring Volume discharged Temp Spec.Cond. Date Time рΉ Turbidity Appearance of water (gals) (F) (mS/cm) (DTM) and comments 2450 2-18-97 1400 300 2 2450 100 1405 1405 110 Progressivay 1410 93 2440 1410 Water Level Recovery Data Start of recovery Date: Time: Water Level (feet) Date Clock Time Elapsed time Monitoring (hh:mm) (mins) Measurement point:



Sheet 1 of Laidlaw/ Westlake Location 14-2 MO Date: Time: 030 Monitored by: Well/Piezometer Data (circle one) Depth of well (from top of PVO or ground) fect Depth to water (from top of PVO or ground) fcet Radius of casing inches feet Casing Volume cubic feet 4.93 gailons Development/Purging Discharge Data HAIJESS Steel Purging method Start Purging Date: 1010 1100 Stop Purging Date: Time: Monitoring Volume discharged Sp∞.Cond. Date Time Temp pН Turbidity Appearance of water (gals) (mS/cm) (UTV) and comments (F) ba1 7,07 5.2 7 1248 1028 5.86 2020 2110 5.68 1935 10 510 5.62 1234) クケフ 20300 51.0 15 20 1109 3/1/97 Water Level Recovery Data Start of recovery Date: Time: Water Level (feet) Clock Time Elapsed time Monitoring Date (hh:mm) (mins) Measurement point:



						Sheet 1 of
Location	Laidlan	/ WeHlake	04-2	1 mo	MV	V-1201-SS
Monitored by:		Date:	211	9/97	Time:	[[30
Well/Piezometer Da	D. Bhang ata			•		
						•
Depth of well (from top o	(circle one) of PVC or ground)		149.	. 3	fcct	
Depth to water (from top	of PVC or ground)		107.	50	fcct	
Radius of casing			2		inches feet	
Casing Volume					Cubic feet	
			7.4	olo	gallons	
Development/Pur	rging Discharge I	)ata				
Purging method			610	nd tos	2 ump	
Start Purging		Date:		197	Time:	1130
Stop Purging		Date:	2 10	9 97	Time:	1215
					-	
Monitoring						
Date Time	Volume discharged	Temp	РH	Spec.Cond.	1	1
2 19 97 1150	(gals)	(F)   58.4	8.65	(mS/cm) 592	(NTU) 8	and comments
21717	2.5	58.1	8.50	570	1 6	l l
Į į	5.0	58.8	8.83	580	7	
1200	7.5	158.0	18 25	687	379	cloudy
	<u> </u>			. 1	<del> </del>	10 /
	w	Il rou	Mi al	Jour to	Herover	illefore remotify
			17/			
ļ.	<u> </u>	<del> </del>	<u>                                     </u>		-	
<u></u>	<u> </u>	<u> </u>	<u></u>		<u> </u>	
Water Level Reco	overy Data					
Start of recovery		Date:			] Time:	
Monitoring	Date	Clock Time	Elapsed			Water Level (feet)
		(hh:mm)	(mi	us)	Measureme	nt point:
					<del>                                     </del>	1/1/
					7.1	· \
				011		
1			TAB,	A-		
}		70	<del>\</del>	<del>////</del>		
		190	//\ <del>\</del>			
			<del> </del>			

Depth of well: 225.8

Dipth to wat: 146.8

Casing radius: 2"

Well volve: 12.87 gallons

priging method: Grandos prop

Stat: 920

Time	vol dischangel	Time	PH	1 con	1 -1 bidit	Comets
925	Z gal	59.Z	6.81	796	218	
935	6	59.5	7.08	817	67	clear
945	10	60.7	7.18	832	44	" "
55	15	60.5	7.13	823	51	
1010	20	60.2	7.11	789	14	
1225	25	60.7	7.13	790	2	
1045	38					1 c/eer

well son dry allow to recover before sorphing



Sheet 1 of \_\_\_\_\_ 1 Westlake MW-103 Location 04-2 MD CPH Date: 2.27.97 Time: 845 Monitored by: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) 18.4 feet Depth to water (from top of PVC or ground) 84 feet Radius of casing linches feet Casing Volume cubic feet gallons Development/Purging Discharge Data Purging method Durys 345 Date: Start Purging Time: 900 Date: Time: Stop Purging Monitoring Temp Volume discharged Spec.Cond. Turbidity Appearance of water Date Time pН (علمع) (T) (mS/cm) (DIN) and comments cloudy -46000/9 (cea 2-22-97 895 1.0 50.5 904 43 32 1.5 22 2.0 6.73 23 920 50.0 0 IB pelieum Water Level Recovery Data Start of recovery Date: Time: Clock Time Water Level (feet) Date Elapsed time Monitoring (hh:mm) (mins) Measurement point:



Sheet 1 of \_\_\_\_\_ Westlake Location GW-107 04-2 MO Date: 2.25-97 Time: 1100 Monitored by: Well/Piezometer Data (circle one) Depth of well (from top of PVC or ground) 17.7 feet 5.37 Depth to water (from top of PVC or ground) feet Radius of casing inches feet Casing Volume cubic feet 2.0 gallons Development/Purging Discharge Data Purging method Pump Date: Time: Start Purging Stop Purging Date: Time: Monitoring Temp рΗ Turbidity Date Time Volume discharged Spec.Cond. Appearance of water (gals) (F) (mS/cm) NTU and comments 7.41 51.6 2.25.97 900 3 1430 29 26 50.1 7.23 1400 50.3 8 7.08 1420 50.5 6.95 1570 4.5 51.6 1600 51.1 .80 1580 unecliptul to Doursel and Water Level Recovery Data Start of recovery Date: Time: Water Level (feet) Clock Time Monitoring Date Elapsed time (hh:mm) Measurement point: (mins)

APPENDIX B.2
Well purging forms, May 1997



Location	P	2-100-55		·			
Monitored by:		1.	Date:	5/14/9	7	Time:	10:55
Well/Piezom	eter data				<del></del>		
Deal of the		(circle one)				7 6	
Depth of well (f				L	95.99	feet	
Depth to water (	from top of	PVQ or ground)			72.38	feet	
Radius of casing	Radius of casing				2	inches	
				L		feet	
Casing volume	Casing volume					cubic feet	
				3. 8	<u> </u>	gallons	
Developmen	t/Purging	g discharge data					
Purging method				PUMP			
Start purging			Date:	5/19	1/11	Time:	11:00
Stop purging			Date:			Time:	1122
Monitoring				L		ا	L
	<del></del>		T			T	
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
5/14/87	1100	97 /	70.0	7,27	965	12	
	1103	<del>\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\</del>	65.7	7.110	318	18	
	1108	图3.5	65.7	7.18	785	36	
	1110	95	65.3	7.20	7 <i>71</i> 780		
	1112	6	61:7	T - 2U	7.91/	30	1. Parry
	1112	<b>V</b>					136416-
		//	ell pen	Dry De	molo de		peraent
			<u> </u>		1900	- <u>8</u> - y	
				1			
Water level		data	_				
Start of recovery	,		Date:			Time:	
Monitoring		Date	Clock time (hh:mm)		sed time mins)	Measuremen	Water level (feet)
			(111.11111)			Weasuremen	n point.
				1		<del> </del>	
				1/1	1/1/	<del> </del>	<del></del>
			— - <u></u>	~~~	70		

WATER
MANAGEMENT
CONSULTANTS

Location	1	7-100-50		·			
Monitored by:	$\Box$	Sha in	Date:	5/2	1/97	Time:	7:26
Well/Piezom	neter data						
		(circle one)		<u></u>		<b>.</b>	
Depth of well (f	ron top of P	VC or ground)			17-47	feet	
Depth to water (	(from top of I	PVO or ground)			96.92	feet	
Radius of casing	g					inches	
						feet	
Casing volume						cubic feet	
				2	4.5	gallons	
Developmen	t/Purging	discharge data					
Purging method	-	_					
				Corvial)	to; pum	- boler	
Start purging			Date:	5/21	197	Time:	1:50
Stop purging			Date:	5/2/	<del></del>	Time:	4.70
Monitoring						_ ·	
Date	Time	Volume discharged	Temp	pH	Spec. cond.	Turbidity	Appearance of water
		(gals)	(°F)		(mS/cm)	(NTU)	and comments
5/21	1.50	5	680	7.04	631	-	Very ditty turbidity
<u> </u>	1.53	10 15	68.3	7.08	631	601 272	clerty gra
	7:00	20	69.5	7.08	636	109	Cyc Hi y chorer
	7:01	23	693	7:0	639	63	4
buil to	ļ	33 gal					
		well	rendu	1 Dens	Rocalto re	covery	
				7 /2/9	7.9-51 /32		
Water level	-	ata	_			<b>.</b>	
Start of recovery	Y		Date:	L		Time:	
Monitoring	,	Date	Clock time (hh:mm)		osed time mins)	1	Water level (feet)
			(111.11111)	,		Measuremen	n point.
						-	
				-	·		
	1				<del></del>		-
			·	<del></del> -			
	!						



Location	P	2-102R-55					
Monitored by:	no	10 10C/C	Date:	5/11/1	7	Time:	1320
Well/Piezom	eter data	<del></del>					
		(circle one)				<b>-</b> 7 .	
Depth of well (fi	rom top of P	VC or ground)		91	42	feet	
Depth to water (	from top of	PVC or ground)		61		feet	
Radius of casing	3				2	inches	
						fcet	
Casing volume						cubic feet	
				4	.9	gallons	
Developmen	t/Purging	discharge data					
Purging method				6 Pans	o, Tetlon Bu	nles	
Start purging			Date:	[ E ] [ Y ]	47	Time:	1320
Stop purging			Date:			∟	
			Date.	5/14/	7 **		
Monitoring							
Date	Time	Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
5/14/93	1310	1	62.1	7,20	949	65	
1	13/8	2	6/19	7.18	931	57	Oruntos
	1323	3	62.3	7.22	895	14	
	/330	9	62.2	7.21	915	9	~~~
	1340	3		<del></del>	-		- pilos
			<del> </del>		1 11		
		well	ran dr	4 mm	77.0	erovery	
				1, 00		1	
		<u> </u>	l	<u> </u>	<u> </u>	<u> </u>	
Water level i	recoverv	data					
Start of recovery	=		Date:	<u></u>		Time:	
				L		.J L	
Monitoring		Date	Clock time (hh:mm)		psed time (mins)	Measurement	Water level (feet)
				<u> </u>			
					0	<u> </u>	
					M		
				X X	ni		
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						<del>                                     </del>	<del>\</del>
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Location		77-104-55					· _
Monitored by:		D. Shan	Date:	5/20/9	7	Time:	11:12
Well/Piezom	eter da	ıta /		7 -7	<u>-</u>	_	
Depth of well (f	rom (op c	of PVO or ground)		14	7.07	feet	
Depth to water (	(from top	of PVC or ground)		4	7.69	feet	
Radius of casing	3					inches	
				·	feet		
Casing volume						cubic feet	
				8	2	gallons	
Developmen	t/Purgi	ng discharge data					
Purging method				Grunto	Any i has		
Start purging			Date:	5/20		Time:	11:20
Stop purging			Date:	5/20	)	Time:	12;25
Monitoring						_	
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
5/20/97	11:28	3 1	63.7	8.30	931	260	
	11-31		64.0	8.12	858	9	
	11-3		03.5	8,10	847	용	
	11:35		64.5	808	852	7 ¢	
	11:27	6	05.1	8.06	884		
<u> </u>	11:39	<del></del>	65.6	8.03	GB 5	5	
Jump 12		8					
bael to		12		1	<del></del>	Λ,	
			well	sond	4 sent	b also	Scall
Water level	recover	v data			1	V	Ü
Start of recovery		, ====	Date:	<u> </u>		Time:	
Monitoring		Date	Clock time	Class Class	cod time	J	Water level (feet)
Monttoring		Date	(hh:mm)		sed time mins)	Measureme	
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WATER
MANAGEMENT
CONSILITANTS

CONSULTA	<u> 1912</u>	Gw-10;	1-5D				
Location		Lada /	) v - 2/ml	)			
Monitored by:	M	5 . 1	Date:	5/22	197	Time:	1:00
Well/Piezor	neter data				1	_	
Depth of well (	from top of P	(circle one)			248.59	feet	
Depth to water	(from top of	PVC or ground)			72.27	feet	
Radius of casin	ıg				2	inches	
	J			ļ —		feet	
Casing volume						Cubic feet	
				20	6.1	gallons	
Developmei	nt/Purging	discharge data				1	
Purging method	d			Grants	3 1000		
Start purging			Date:	5/:		Time:	1:15
Stop purging			Date:			Time:	
Monitoring				<del>\</del>			
Date	Time	Volume discharged	Temp	рН	Spec. cond.	Turbidity	Appearance of water
5/22/97	/: 20	(gals)	(°F)	7,97	(mS/cm) 992	(NTU) (; 7	and comments
1/22/9/	1.53	10	64.0	7 94	970	19	
	1:26	15	63.2	7.91	1510	26	
	1:28	18	63.2	7. 90	1013	16	
	1.3 C	22	63.8	7. 38	1029	16	
	1:34	2.5	64.3	7.87	1020	16	<u></u>
	2:03	35	2 ، ق ی	7.94	1058	86	
	2:48	45	558	7.97	1042	36	ļ
	3110	57	66.2	7,97	1047	56_	
	342	6.0	66.3	7.95	1034	35	<u> </u>
Water level	IGU recovery	data & told	somple in	irediately	ofto peur	*c)	
Start of recover	У		Date:			Time:	
Monitoring		Date	Clock time (hh:mm)		nsed time mins)	Measureme	Water level (feet) nt point:
				7			
			-	2061			
				W			
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							<del></del> _



Location PZ-106-55	
Monitored by: Date: 5/20/97 Time: 4	8:45
Well/Piezometer data	<u> </u>
Depth of well (from top of PVO or ground)  [Circle one]  [166.75]  [Circle one]	
Depth to water (from op of PVC or ground) 77.00 feet	
Radius of casing Z inches	
feet	
Casing volume cubic feet	
14.5 gallons	
Development/Purging discharge data	
Purging method  Grandles from + tu-/	
Start purging Date: 5/20 Time: 9	3750
Stop purging Date: Time:	
Marianian	
Monitoring	
(gals) (°F) (mS/cm) (NTU)	Appearance of water and comments
5/20 4:00 2.5 61.2 7.56 897 12	
9:04 5.0 59.1 7.85 838 7	
9:09 75 575 7.93 824 8	· — — — — — — — — — — — — — — — — — — —
9:11 12 60.1 7.98 836 8	
9:14 12.5 59.8 7.94 7.79 7	
3:18 15.0 60.7 7.95 850 9	
	of opposing hotel
Prup to 17.5	
backer to Z3 ja	
A De la 20 au	
Water level recovery data well rendy, sende of a recovery	
Start of recovery Date: Time:	
Monitoring Date Clock time Elapsed time Water (hh:mm) (mins) Measurement poin	r level (feet) nt:
	l l



Location	P	7-106-50					
Monitored by:		Shan "	Date:	5/15/		Time:	[
Well/Piezo	کیا meter data				<u> </u>	<b>-</b>	
		(circle one)				_	
Depth of well	(from op of P	VC or ground)			203.07	feet	
Depth to water (from op of PVC or ground)				83	3.08	feet	
Radius of casing						inches	
						feet	
Casing volume	e			[ <del></del>		cubic feet	
				19.	6	gallons	
Developme	nt/Purging	discharge data					
Purging metho	od			G. p.	ing ba	. t	
Start purging			Date:	5-/	15	Time:	
Stop purging			Date:		<u> </u>	Time:	
			23.5		<del></del>		
Monitoring							
Date	Time	Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
5/15	8:32	2,5	5.7.5	8.25	1324	47	
, ,	3:35	5.0	58.0	8.12	7085	15	
	9 40	10.0	58.5	8.11	10.89	10	
	9.13	12.5	58.9	8.14	1084	9	
	8 76	15.0	59.1	8.11	1093	1	
	3-44	17.5	578	८,०५	1101	14	
77-7-	552	۵۰.۵	615	8.00	1105	15	
Buler	-						<del> </del>
		2.5	<b></b>	,	<b>h</b>		
		well	ran du	Danjo	le after re	rovery)	
Water leve	l recovery (	data	V	,	ı	/	
Start of recove	ry		Date:			Time:	
Monitoring		Date	Clock time (hh:mm)		psed time mins)	Measuremen	Water level (feet)
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WATER	
MANAGEMENT	
CONSULTANTS	

Location		PZ-106-SD							
Monitored by:	П	Shay	Date:	5/11/	97	Time:	7:00		
Well/Piezom	کت eter data			<del>- 31.11</del>	1 1	.1			
(circle one) Depth of well (from top of PVC or ground)				20	3.07	feet			
Depth to water (	from top of 1	PVC or ground)		112	2,00	fect			
Radius of casing				7		inches			
						feet			
Casing volume				14.8			cubic feet gallons		
Developmen	t/Purging	discharge data							
Purging method				Grund	los Ivma	+ bail			
Start purging			Date:	s/	17	Time:	3:05		
Stop purging			Date:	5/	19	Time:	4:55		
Monitoring						<b>.</b>			
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments		
5/17	3:18 pm	2.5	63.5	7.02	922	74			
ļ	3 22	5.0	61.1	7.00	897	30			
	3-26	7.5	61.7	6.99	9/8	28			
	3:29	10.0	<u>11.8</u>	699	915	30			
	3:32		61.9	6.98	419	52			
Dung to		15							
10.1 to		20	<u>-</u>						
10 U.1 to									
		wel	rond	Luse. M	li altos	reroveu			
Water level r	ecovery d			1, 1009		(	J		
Start of recovery			Date:			Time:			
Monitoring		Date	Clock time (hh:mm)		osed time mins)	Measureme	Water level (feet) nt point:		
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						<del>                                     </del>			
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Location		PZ-110-55							
Monitored by:	D.	Sha	Date:	5/29/9	7	Time:	7:50		
Well/Piezom				- test		1			
Depth of well (from top of PV) or ground)				<u></u>	3.57	feet			
Depth to water (	from op of I	or ground)		38	90	feet			
Radius of casing					2	inches			
_						feet			
Casing volume						cubic feet	- cubic feet		
•				12	2.2	gallons			
Development	Development/Purging discharge data								
Purging method				Grund	os brook +	· Jail			
Start purging			Date:	5/29/9	7	Time:	17:57		
Stop purging			Date:	5/29	197	Time:	9:10		
Monitoring				77		_			
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments		
5/27/97	800	2	57.3	197	1949	75			
	803	4	59.7	6.23	1987	55			
	806	٤	59.3	6.37	1987	16			
	809	Ø	59.3	6.39	1996	10			
bailer ->	832	10	60.0	6.34	2040	128	grywoty w/boiling		
ν	842	۱۷	60.0	6.37	7040	>51	, , , ,		
	854	14	59. ?	6.31	1960	423			
rail to		17							
-			4.4		4 4				
		Wel	lrond	lu son	all offer 1	eceny			
Water level r	ecovery			1, 1	Į.	1			
Start of recovery			Date:		. —	Time:			
Monitoring		Date	Clock time		sed time		Water level (feet)		
	į		(hh:mm)	(1	mins)	Measuremen	nt point:		
			<u> </u>						
						<u> </u>			
	j								
	ĺ								
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Location	PZ	1-111-50					
Monitored by:	JR	.M5	Date:	5/16/9	7	Time:	
Well/Piezom	eter data			<del></del>		<b>-</b>	
Depth of well (f	rom top of P	(circle one) VC or ground)		212	.33	feet	
Depth to water (from top of PVO or ground)					29	'   feet	
Radius of casing				2		inches	
						feet	
Casing volume						cubic feet	
				29	. 3	gallons	
Developmen	t/Purging	discharge data					
Purging method							
Start purging			Date:	5/16/9	7	Time:	<b>2</b> 1434
Stop purging			Date:			 Time:	
Monitoring				L	<del> </del>	_]	
	Time		Т		1 6	1 7	Appearance of water
Date		Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	and comments
5   <u>ii</u>	17 39	5	72° 629	8.16	933	4	
	-	i0 15	52.7	3,16	905 916	4	
		20	62.3	8.18	916	3	
		>6	63.3	8.17	937	6	
Bailer -		30					
04147		30		<u></u>			
		. 47			1. 04		
<del></del>		well	rondr	Y DOM	pregin	recover	
Water level	recovery o	lata			,	(	J
Start of recovery	,		Date:			Time:	
Monitoring		Date	Clock time		osed time		Water level (feet)
			(bh:mm)	(	mins)	Measuremen	it point:
					7		
	!				7/		
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Location	F	2-113-45							
Monitored by:	[M	3	Date:	.5/28/97		Time:	10:45		
Well/Piezon	neter data				·	_			
(circle one) Depth of well (from top of PV) or ground)				41.5		feet			
Depth to water	(from op of	PVC or ground)			7.20	feet			
	_					」 □ inches			
Radius of casing				2		feet			
Casing volume						cubic feet			
•				2.3	3	gallons			
Developmen	t/Purging	g discharge data							
Purging method	l			Grund	Grundo, pup				
Start purging	Start purging					Time:			
Stop purging			Date:			Time:			
Monitoring						_1			
	<u> </u>	No.	T	111	I C	Total Sales	Appearance of water		
Date	Time	Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	and comments		
5/28/97	10:57	2	66.5	6,97	1583	7			
	10:55	3	66.1	6,91	1571	5			
	11:00	4	65.6	6.87	1572	4			
	11-02	5	65.7	6 86	1573	3			
	11 03	6	65.1	6.84	1564	3			
	11:04	7	64.7	6.83	1563	2			
	<del>                                     </del>		10	1 12,	efte se				
_	ļ	Dem	de Inne	Melan	of or	rguy			
	ļ			'	/				
	<u> </u>					<u> </u>			
Water level	recovery	data							
Start of recover	y		Date:			Time:			
Monitoring		Date	Clock time (hh:mm)		nsed time mins)	Measureme	Water level (feet) nt point:		
						-			
					<del>- ·</del>	<del> </del>	· · · · · · · · · · · · · · · · · · ·		
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Location		PZ-113-A	+D_						
Monitored by:	M	25/5DR.1	Date:	5/21	197	Time:	INOU		
Well/Piezom	eter data			,					
Depth of well (f	rom top of P	(circle one) VC or ground)			0.3	feet			
Depth to water (	from top of I	PVC or ground)		2	7.38	feet de	22-68		
Radius of casing				2	inches feet				
Casing volume					3.5	cubic feet	_}		
Developmen	t/Purging	discharge data			,				
Purging method				(c.)	- Δ				
Start purging			Date:	5/21	197	Time:	0720		
Stop purging			Date:	5/21	(177	Time:	12946		
Monitoring									
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments		
5/2/197	9:20	5	64.9	474	1660	16			
	9:24	11)	62,6	6 75	1676	Y	Cler		
	9:27	15	61.6	15.75	1690	3			
	4:30	21)	61.3	574	1690	2			
	9:33	15	61.3	6.70	1690				
	9:36	30	<u>C1.0</u>	6.72	1670	2			
	9:39	35	610	6.70	1690	j			
	9.72	40	60.9	6.70	1690	3			
	9.76	42	60.9	1.70	1690	2			
<u> </u>		<u></u>	concle.	lunatol	ofter	seeselin			
Water level	recovery (		/	·	1 /	/ /	,		
Start of recovery	•	Ĺ	Date:			Time:			
Monitoring		Date	Clock time (hh:mm)		osed time mins)	Water level (feet) Measurement point:			
			<del></del>	<del>\</del>		<del> </del>			
	:			<del>  \                                   </del>			<del></del>		
			<del></del>	1	<del></del>	<del> </del>			
				<u> </u>	(1/2	*	···· <del>-</del>		
					C/2	<del></del>			
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			<del></del>	<del> </del>	$\overline{}$	<del>                                     </del>			
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Location	PZ	1-113-55								
Monitored by:	D.	5	Date:	5/28/	97	Time:	12:45			
Well/Piezon	neter data				<u>:</u>					
		(circle one)				<b>-</b>				
Depth of well (	from top of P	VD or ground)		160	-21	feet				
Depth to water (from op of PVS or ground)				2	7. 46	feet				
Radius of casing				2		inches				
						feet				
Casing volume						cubic feet				
				21.	7	gallons				
Developmen	Development/Purging discharge data									
Purging method	1			910-16	s flag 1 1	4-1				
Start purging			Date:	5/28/	- <i>1 /</i>	Time:	12:55			
Stop purging			Date:	7 7		Time:				
Monitoring						_				
Date	Time	Volume discharged	Temp	рH	Spec. cond.	Turbidity	Appearance of water			
Date		(gals)	(°F)		(mS/cm)	(NTU)	and comments			
3/28	12:56	2,5	636	7.46	620	53	1 1			
	12:59	5.0	63.7	7.34	617	13				
	1:05	7.5	!3,3	7.18	615	1_11_				
	1:04		636	7.13	619	9				
Dury to	1	12.5					6. Yung			
	1200	2 <b>4</b>					T. Brib			
	ļ	we	l rond	W, 1	ingle of	to rece	eu			
	ļ <u> </u>		·							
	<u> </u>				<del></del>	<u> </u>				
Water level	PAGOMETI Ó	lata								
	•	iata	Data			¬				
Start of recovery	y		Date:		<del></del>	Time:				
Monitoring		Date	Clock time (hh:mm)		sed time nins)	Measureme	Water level (feet)			
			(101.1110)	(1		Measureme	ent point.			
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Location		PZ-304-AI						
Monitored by:	[ NV.	25/JDR .	Date:	5/1	1/97	Time:	0900	
Well/Piezom						_	<u> </u>	
		(circle one)				7.0		
Depth of well (fi	rom top of P	VC or ground)		52	), 42	feet		
Depth to water (	from top of F	PVC or ground)		19	.99	feet		
Radius of casing				1		inches		
						feet		
Casing volume						cubic feet		
				5.3	gallons			
Developmen	t/Purging	discharge data						
Purging method					6.P-P			
Start purging			Date:	5/1	7/97	Time:	(1)83()	
Stop purging			Date:		-(	Time:		
			54.0.	(	<del></del>	]	L	
Monitoring							<u>,,</u>	
Date	Time	Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments	
5/19/17	050	.3	69.7	6.81	1970	3		
		9	71.5	6.65	2040	3		
		12	70.7 69.3	6.69	1950	2		
		13	69. i	6.70	1900	<del></del>		
		11	69,6	6.69	1880	3		
				1	A 4			
		کی کی ک	wold in	ediatex	1 of the pu	airel		
					V	\ <u>'</u>		
							<u></u>	
Water level i	recovery o	lata						
Start of recovery			Date:		·	Time:		
Monitoring	1	Date	Clock time	Flan	sed time	<del></del>	Water level (feet)	
rionitor mg		- Date	(hh:mm)		mins)	Measureme		
						ļ	<del></del>	
					$\overline{}$	<del> </del>	<u> </u>	
	ļ				7/1	<del></del>		
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Location	P	72-304-45						
Monitored by:	[ N	(5 05	Date:	5/20/9	7	Time:	1:45	
Well/Piezom	eter dat	a				_		
Depth of well (fr	rom(top of	(circle one) PVC or ground)		3	0.31	feet		
Depth to water (	from top o	f PVO or ground)			9 74	feet		
Radius of casing					2	inches feet		
Casing volume					6	cubic feet gallons		
Development	t/Purgin	g discharge data						
Purging method Cival for pany								
Start purging	Start purging			5/2	c'	Time:		
Stop purging			Date:			Time:		
Monitoring								
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments	
			727	7.62	2570	12		
		2	69.1	7.63	2470	8		
		<u>)</u>	69.3	7.66	2770	12		
		7	68.5	7.58	2440	12		
		5	68-1	7.55	7430	[]		
		<del> </del>			<del></del>	ļ		
		10	nole en	in the	- 1 h	PUBUR		
		AC)	moe in	red Low	after 1	riagray 7		
Water level r	recovery	data			-			
Start of recovery			Date:			Time:		
Monitoring		Date	Clock time (hh:mm)		osed time mins)	Measureme	Water level (feet) nt point:	
•								
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Location	b	2-303-45				····-				
Monitored by:	71	2	Date:	5 29 9	7	Time:	12:15			
Well/Piezometer data										
Depth of well (	from top of	(circle one) PVO or ground)		2.5	3.88	feet	feet			
Depth to water	(from op of	PVC or ground)		19	.15	feet				
Radius of casing				2	`	inches feet				
Casing volume				i .6		cubic feet gallons				
Development/Purging discharge data										
Purging method	i			Gruntos punt						
Start purging			Date:		_1	Time:				
Stop purging			Date:			Time:				
Monitoring						-				
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments			
5/29/37	1235	1	71.1	5.74	2280	-	very dirty			
<u> </u>	1237	2 3	68.0	5.70	2230	159	getty clearer			
	1272	<del>  3</del> -	70.0	5.67 5.61	2210	18				
	1244	5	69.0	5.60	2220	17				
		<u> </u>	٨		Λ		,			
			semple	unede	with often	Jugu	re/			
					V		/			
ļ	-	<u> </u>								
Ĺ	<u> </u>	<u> </u>								
Water level	recovery	data								
Start of recover	у		Date:			Time:				
Monitoring		Date	Clock time (hh:mm)		sed time mins)	Water level (feet) Measurement point:				
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						<del> </del>				
						<u> </u>				



Location		72-301-5	5							
Monitored by:	<u> </u>	DR/M25"	Date:	5/14	117	Time:	[010]			
Well/Piezom	eter data	7.1			<del>{-`-!</del>					
Depth of well (f	rom top of P	(circle one) VC or ground)			-5	] feet				
Depth to water (	from top of F	VC or ground)			7.32	feet				
Radius of casing	3				2_	inches				
						feet				
Casing volume				7	.2	cubic feet gallons				
Developmen	Development/Purging discharge data									
Purging method				Gund	by pump 1	tellon	halen			
Start purging			Date:		15/14/97	Time:	0920			
Stop purging			Date:		05/14/97	Time:	0455			
Monitoring				<u> </u>	*	-				
Date	Time	Volume discharged	Temp	pН	Spec. cond.	Turbidity	Appearance of water			
5/14/93	0920	(gals) 2	(°F) 61.5	7.31	(mS/cm) 704	(NTU)_	and comments			
<del></del>	0925	4	6D-1	7.31	6617	52	de			
	0930	6	59-8	7 40	710	19	dean			
	1/933	7	51.2	7.45	735	12	die 1			
	1935	8	62.5	7.43	734	11 -	(rules			
	0955	9		<del></del>			Barler			
<u> </u>	4.		al een o	ery son	ste Sto					
			er ion o	VIII LIEVI	you gere	recovery				
<b></b>				<del>  '</del>						
Water level	recovery d	lata		4		-				
Start of recovery	,		Date:			Time:				
Monitoring		Date	Clock time (hh:mm)		sed time mins)	Measureme	Water level (feet)			
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					Lung	<del> </del>				
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Location		2-208-55					
Monitored by:		5L.	Date:	5/27/	97	Time:	11:00
Well/Piezom	eter data			<del></del>	· · · · · · · · · · · · · · · · · · ·	•	
Depth of well (fi	rom top of P	(circle one) VOor ground)		100	.92	feet	
Depth to water (	from (op of I	PVG or ground)		4	V. 47	feet	
Radius of casing				2		inches	
Casing volume	Casing volume			9	.78	cubic feet	
Developmen	t/Purging	discharge data					
Purging method				Grunttos	puno + b	<u></u>	
Start purging			Date:	5/2	100	Time:	11.06
Stop purging			Date:			Time:	
Monitoring						•	
Date	Time	Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
5/27/97	11:08	ス	60.2	6.18	1668	67	A
<u> </u>	11:12	4	60.6	6.34 6.57	1684	15	<del>-</del>
ļ	11:16	6	62.3	6.58	1710		<del>                                     </del>
	11:20	8	67.5	6.20	1729	6	
	11:21	9	62.9	6.60	1739	7	
	11:23	10	63.5	6.75	1752	7	God
	1200	15			-		T- Bul
			roudry		1. na	<del></del>	eru
		<u> </u>	nouchy	, som	Ke ofter	recor	rery
Water level i	ecovery d	lata	1		V		r
Start of recovery			Date:			Time:	
Monitoring	1	Date	Clock time (hh:mm)		osed time mins)	Measureme	Water level (feet) nt point:
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Location	P	7- 204A.55							
Monitored by:		4.	Date:	5/16/	197	Time:	1106		
Well/Piezom	neter da	ta				_			
Depth of well (f	rom top of	(circle one) [PVC or ground)		91.5	0	feet	] feet		
Depth to water (	(from top o	of PVC or ground)		63.8	5	feet			
		_				_inches			
Radius of casing					<u> </u>	feet			
o : .						al Dankin faar			
Casing volume				<del>ار</del> بر 5	<u> </u>	gallons			
<b>n</b> 1		19 1		9.2		J ~			
Developmen	<i>V</i> Purgir	ng discharge data				_			
Purging method				6 Pu	y Barba	·			
Start purging			Date:	5-16-	97	Time:	//:20		
Stop purging			Date:			Time:			
				L	···-	]	L		
Monitoring									
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments		
5-10-97	11:28		65.3	4.07	478	61			
	11:34	2	62.5	9	हुन्प	17	<u> </u>		
<del>                                     </del>	11:36	3	63.5	9.71	911	54	<del> </del>		
balle-		5	651	2.66	1038	94			
	<del> </del>		642	3.67	1030 1040	94	arll grove din		
	<del> </del>	5 7	65.6	8.65	1020	261	strang cladice		
				9.124			each backer for		
			1	0	0.1				
		well re	andly,	sample	ofto re	eevery			
33/- A 1 1		. 4-4-	1	1	/	1			
Water level	-	y data				_			
Start of recovery	/		Date:			Time:			
Monitoring		Date	Clock time (hh:mm)		sed time mins)	Water level (feet) Measurement point:			
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•				<del>                                     </del>		ļ			
				<del> </del> -					
		<u> </u>				<del> </del>			
						<del> </del>			
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Location	P	Z-201A-55					· · · · · · · · · · · · · · · · · · ·	
Monitored by:	$\square$	Sha	Date:	5/14/9-	 )	Time:	1:15	
Well/Piezom	eter data	7		- ( - (		_		
(circle one) Depth of well (from top of PVC or ground)				9181		feet		
Depth to water (	(from top of I	PyOor ground)		65	. 97	feet		
Radius of casing				2	2	inches		
Casing volume				7.	2	cubic feet		
Developmen	t/Purging	discharge data						
Purging method				Bailer				
Start purging			Date:	5/17/9	7	Time:	1:20	
Stop purging			Date:	5/14/	97	Time:	2:00	
Monitoring				<del></del>		<b>-</b>		
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments	
5/14/97	1: 25	1	68.1	7.38	688	11		
/	1.40	2.5	6-1.6	7.3?	795	130		
	1 45	3.5	65.6	7.40	829	124		
	150	5.0	64.4	7.38	B15	361		
	155	5.5	65.1	7,43	812_	863		
			<i>1</i>	1		ļ		
		well re	on dry	somple	Alex r	ernew		
			<i></i>	1		<del> /-</del>		
Water level		lata	Date:			Time:		
Monitoring		Date	Clock time (hh:mm)		sed time nins)	Water level (feet) Measurement point:		
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	Ì							
				<del> </del> -				



Location		12-206-55					
Monitored by:		URS/JDR	Date:	5/20	197	Time:	0900
Well/Piezomet		7		,	1	_	
Depth of well (from	m top of P	(circle one) VC or ground)		127	32	feet	
Depth to water (fro	om top of F	PVC or ground)		41	1).54	feet	
Radius of casing				2	~	inches feet	
Casing volume					1.1	cubic feet	
Development/l	Purging	discharge data					
Purging method				C. 6	-Parp		
Start purging			Date:	5/2	0/97	Time:	0745
Stop purging			Date:	5/20	7/47	Time:	
Monitoring					T	-	
Date	Time	Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
5/20/17	A749	6	(1), 3	6.83	1002	5	clia
<b></b>	1007	12	15.2	6.41	1068	3	clean
	1106	18	66.7	1,83	1097	2	clean
	1306	30	(27,3	6.80	1051	3	Okan,
	1406	36	67.2	6.75	1031	2_	
	1500	42,5	67.3	6.79	1042	-3	
		·	100	- 0.1	A - A	1.1 11	
			well s	omple	1 insolut	THE OF THE	surgen
Water level red	covery d	ata					
Start of recovery			Date:			Time:	
Monitoring		Date	Clock time (hh:mm)		sed time mins)	Measuremer	Water level (feet)
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	}						
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	}					<del></del>	



Well/Piezometer data  (circle one) Depth of well (from top of PVC or ground)  Depth to water (from top of PVC or ground)  Radius of casing  Casing volume  Casing volume  Casing volume  Development/Purging discharge data  Purging method  Start purging  Date: 1/2/17  Time: 1/30  Date: 1/31  Date: 1/31  July 1/30  July 1	Location	M	W-103					
Depth of well (from top of PVC or ground)  Depth to water (from top of PVC or ground)  Radius of casing  Casing volume  Development/Purging discharge data  Purging method  Start purging  Date: 1/2/17 Time: 1/30  Stop purging  Date: 1/2/17 Time: 1/4/30  Date: 1/3/17 Time: 1/4/30  Date: 1/3/1	Monitored by:	JK		Date:	5/29/9	7	Time:	21425
Depth of well (from top of PVC or ground)  Depth to water (from top of PVC or ground)  Radius of casing  Casing volume  Casing volume  Casing volume  Development/Purging discharge data  Purging method  Start purging  Date:  Time:  Monitoring  Date:  Time:  Volume discharged (*F) (*F) (mS/cm) (NTU) and comments  (*F) (*S) (*O) 1362 (20)  1731 1 2 3.6 5.85 1335 25  1733 3 (30 5.77 1306 16  1737 1 30 1 (2.2 5.57 1282 )  1738 6 (2.1 5.57 1282 )  1739 6 (2.1 5.57 1282 )  Water level recovery data  Start of recovery  Monitoring  Date:  Elapsed time  Water level (feet)	Well/Piezom	eter data				,		
Radius of casing    Casing volume	(circle one)  Depth of well (from top of PVC or ground)					8.4	feet	
Casing volume    T.O   Start purging method   Crander purging method   Crander purging	Depth to water (	Depth to water (from top of PVC or ground)			6	.32	fcet	
Development/Purging discharge data	Radius of casing					2	inches	
							feet	
Development/Purging discharge data	Casing volume	Casing volume			2.0	)		
Date   Start purging   Date:   Start purging   Date:   Time:   Time:   Stop purging   Date:   Time:   Time:   Monitoring   Date   Time   Volume discharged (gals) (°F)   PH   Spec. cond. (mS/cm) (NTU)   Appearance of water and comments   Start of recovery   Date:   Time:   Monitoring   Date   Clock time   Elapsed time   Water level (feet)   Clock time   Elapsed time   Water level (feet)   Clock time   Elapsed time   Water level (feet)   Clock time   Clock time   Elapsed time   Water level (feet)   Clock time   Clock ti	Developmen	t/Purging	discharge data				-4	
Date   Time   Volume discharged   Temp   pH   Spec. cond.   Turbidity   Appearance of water   (gals)   (°F)   (mS/cm)   (NTU)   and comments	Purging method				Grult	gy pup		
Date   Time   Volume discharged   Temp   pH   Spec. cond.   Turbidity   Appearance of water   (gals)   (°F)   (mS/cm)   (NTU)   and comments	Start purging	Start purging			\$/29/	7	Time:	1430
Date   Time   Volume discharged   Temp   pH   Spec. cond.   Turbidity   Appearance of water   (gals)   (°F)   (mS/cm)   (NTU)   and comments	Stop purging			Date:	, , , , , , , , , , , , , , , , , , ,		Time:	
(gals)	Monitoring						_	
1930   1   65.5   6.00   1362   6.20   1931   7   6.30   5.85   1335   7.25   6.30   5.77   1306   16   6.30   6	Date	Time			pН			
1433   3   630   5.77   1306   16   1435   4   62.5   5.60   1304   11   1437   5   62.2   5.57   1295   60   1438   6   62.1   5.59   1282   70   1438   6   62.1   5.59   1282   70   1438   6   62.1   5.59   1282   70   1438   6   62.1   6438   6   6   6   6   6   6   6   6   6	5/21/97	1430	<u>(gm3)</u>		6.00	<del></del>	<del></del>	and comments
1435   4   C2.5   5.60   304   11   1437   5   (2.2   5.57   1295   10   1438   6   62   1   5.59   1282   10   1438   6   62   1   5.59   1282   10   1438   6   62   1   6	1 1		2	63.6		1335		
1937   5   (2.2   5.57   1295   10   1938   6   62   1   5.59   1282   10		1433	3	630	5.77	1306	16	
Water level recovery data  Start of recovery  Date: Time: Water level (feet)		1435		62.5			11	
Water level recovery data  Start of recovery  Date:  Time:  Monitoring  Date  Clock time  Elapsed time  Water level (feet)		1437					10	
Water level recovery data  Start of recovery Date: Time:  Monitoring Date Clock time Elapsed time Water level (feet)		1438	6	67.1	5.59	1282	10	
Water level recovery data  Start of recovery Date: Time:  Monitoring Date Clock time Elapsed time Water level (feet)						- 4-49	-04	
Start of recovery Date: Time:				well re	mysloce.	(modell)	0200 D	urguel
Start of recovery Date: Time:					/	/	/ /	/ /
	Water level r	_	lata -	Date:			Time:	
	Nemianina	1	Data	Clash time			.J <del>                                       </del>	Wasan Land (fam.)
	Monitoring		Date					
		•			-			
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WATER	
MANAGEMENT	
CONSULTANTS	

Location	M	ນ 10 <b>3</b>						
Monitored by:	□ R	DR .	Date:	6/4/	Ŋ	Time:	1020	
Well/Piezon	neter data			7 -				
Depth of well (i	from top of P	(circle one) "VC or ground)				feet		
Depth to water	(from top of	PVC or ground)		6.0	χ1	- feet		
Radius of casin	0				<u>'.1                                    </u>	inches		
radius of casing	5			2	<del></del>	feet		
Casing volume						cubic feet		
				~	12	gallons		
Developmen	t/Purging	discharge data						
Purging method	l			Grandos	p-p			
Start purging		/	Date:	6/4/97		Time:	1025	
Stop purging			Date:	6/4/97	,	Time:	1034	
Monitoring				, , ,			·	
Date	Time	Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments	
6/4/97	1025	/	63.8		1272	55		
	1027	2	63.3	6.35	1247	16		
ļ	1029	3	63.2	6.21	1249	11		
	1031	4	(2.8	6.20	1247	10		
	1032	5	63.0	6.35	1245	9		
<u> </u>	1034	6	63.2	6.26	1251	9		
	<u> </u>		- ,,	7	1 1 -4	<u> </u>		
			well	ADWY DO	limodust	16/	ļ	
				9.00	andone			
<u> </u>	<u> </u>	<u>L</u>	L				<u>                                     </u>	
Water level	recovery	data						
Start of recovery	ť	·	Date:			Time:		
Monitoring		Date	Clock time (hh:mm)		sed time nins)	Measureme	Water level (feet)	
			<del></del>	1 017		- Treasureme	po	
	•	1 9	M HOU					
	. ()n	H dw 1		177 1		<del></del>		
~ m	MOXI	1	#		<del>\                                    </del>	<del>                                     </del>		
1 2000	1	4 10 m		***				
,	بالكا مير	$D^{O}$		<b>V</b>		<del> </del>		
Lossa.	MAJA	J <b>r .//</b>	<del> </del>					
,	(	D 2021/4		<u> </u>	· <del></del>			
	(	W J _ / CV		<del></del>	<del></del>			
		<del></del>				<del></del>		



Location			MW-107					
Monitored by:	ſ	$\Lambda$	Sha	Date:	6/2/9	77	Time:	100
Well/Piezom	∟ eter d	ata				<del></del>	J	
			(circle one)					
Depth of well (fi	rom (op	of Pr	C or ground)		12.7		feet	
Depth to water (from op of PVC or ground)				5.49		feet		
Radius of casing				2		inches		
						feet		
Casing volume					\$	<del></del> .	cubic feet	
				1.99		gallons		
Development/Purging discharge data								
Purging method G. Qual								
Start purging				Date:	C/5 B	7	Time:	(205)
					(2)0/2			1005
Stop purging				Date:	6/2/9	2	Time:	1025
Monitoring								
Date	Tim	c	Volume discharged (gals)	Temp (°F)	pH	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments
6/247	100	7	/ (gais)	60.9	2/16	1302	37	2.0 00
1-1-1	1010	2	3	60.9	2.16	1302	37	
	1013	?	3	60.3	6.96	1463	ク	Goer
	101	2	4	100.3	6.95	1463	7	
	102		5	6013	6.91	1404	<u> </u>	
	102	5	6	0.5	6.90	1412	5	
		$\dashv$		1.00/	1 10.1	uned 10to	11 - PA	14. 01.10
	ļ	$\dashv$		well is	emplod	MARCOLO YX	y open-	reviews
				<del> </del>				
	<b></b>	L	<del></del>	<u> </u>	<del></del>		·	
Water level r	recove	ry d	ata					
Start of recovery				Date:		<del></del>	Time:	
Monitoring		Г	Date	Clock time	Elan	sed time	- T	Water level (feet)
<b>B</b>				(hh:mm)		mins)	Measuremen	nt point:
	_	$\neg \{$						
		-						
		}		-	<del></del>	/_		
				<del></del>				
-								
				/				
		- 1	/		I		1	



Location		P7-1201	- 55				·		
Monitored by:	[m/	25/5012,	Date:	9/19/97		Time:	[7510]		
Well/Piezon	·			<del></del>					
Depth of well (f	rom top of P	(circle one) VC or ground)		141.31		feet			
Depth to water (	from top of	PVC or ground)		95,92		fect			
Radius of casing	,				2	inches			
radius of casing				<u> </u>	<u> </u>	feet			
Casing volume						cubic feet	cubic feet		
<b>5</b>				9	· ()	gailons			
Developmen	t/Purging	discharge data		<del></del>		_			
Purging method				Gila	my Bale	1			
Start purging			Date:	5114	197	Time:	[151])		
Stop purging			Date:	5/14	17	Time:			
				7/11/1	<u> </u>	]			
Monitoring	·-			,-·	,		<del>,</del>		
Date	Time	Volume discharged (gals)	Temp (°F)	pН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments		
5/14/4+	3.09	P	220	8,20	505	118	1		
' '	3.14	2	67.3	13.52	565	44			
	3.13	~	63.5	8,45	616	15			
	322	4	54.G	9.44	609	7			
	3.72	7	05.2	8.43	636	10	( ) (-		
<u> </u>	3:30	8.5	66.0	840	854	/ 2_	(m)fos		
	11:10	<u> </u>					Jule		
	4:10	10	00/2000	dwg	Now to.	100000			
			e prow	any, a	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	عرصاوي بها			
Water level	recovery o	lata			<b></b>	L	1		
Start of recovery	•		Date:			Time:			
Monitoring		Date	Clock time (hh:mm)		sed time mins)	Water level (feet) Measurement point:			
						-			
-			$\overline{}$						
					A.11	<del> </del>			
-					// <b>/</b> //				
				<del></del>		<del> </del>			



Location	PZ-1204								
Monitored by:	M	5	Date:	5/23/9	r7	Time:	10:05		
Well/Piezometer data									
Depth of well (from op of PVC) or ground)					5. 8	feet			
Depth to water (	from op of	PVO or ground)		110	.00	fect			
Radius of casing	,				2	inches			
						feet			
Casing volume						cubic feet			
B				18	.9	gallons			
Developmen	t/Purging	discharge data				_			
Purging method		<b>.</b>		<del>-2</del>	/ ^ ^				
				Grund	go primp				
Start purging			Date:	5/23	5/97	Time:	10:00 AM		
Stop purging			Date:	5/23	1/77	Time:	10.59 AM		
Monitoring				,	ı		·		
Date	Time	Volume discharged (gals)	Temp (°F)	рН	Spec. cond. (mS/cm)	Turbidity (NTU)	Appearance of water and comments		
5/23/17	10.03	(gais)	67.2	701	378	अन	and comments		
	10:01	10	66.3	6.93	975	24			
	10:11	15	63.0	G. 37	368	12 6			
	10:16	20	65.0	6 84	796	6			
	10:21	25	4.6.7	6.82	808	5			
	10:27	30	66.5	6.85	807	<u>3</u>			
	10:37	40	67.8	6.83	815				
	10:78	50	69.6	6,82	820	3			
	10:59	60	66.1	6.84	811				
			0/1-1	10/1	destaly of	DOR CHIE	<u>                                     </u>		
Water level r	ecovery o	lata	ee seryse	log wind	successful of		7		
Start of recovery			Date:			Time:			
Monitoring		Date	Clock time (hh:mm)		sed time mins)		Water level (feet)		
			(1111.11111)	()		Measuremen	it point:		
					<del></del>				
•									